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CONTENTS

NATIONAL DEVELOPMENTS

POWER NETWORK

HYDROPOWER

THERMAL POWER

COAL

OIL, GAS

NUCLEAR POWER

Continued Strong Growth Noted in Energy Production

916b0009c Beijing RENMIN RIBAO in Chinese 5 Oct 90 p 1

[Article by reporters Liu Xieyang [0491 3610 7022] and Luo Haiyan [5012 3189 1484]]

[text] China's energy production is advancing briskly under readjustment. Coal, electricity, and oil production have reached new heights. By the end of August, coal production had reached 686 million metric tons, 4.87 percent over the same period last year. Electric power production was 402.43 billion kWh, 6.46 percent over the same period last year. Oil and natural gas production exceeded quotas in completing the national plan. Oil production volume reached 91.42 million metric tons, .68 percent over the same period of last year. Natural gas production volume finished out at 9.77 billion cubic meters, 1.51 percent over the same period last year. The fairly rapid increase in energy production has relieved the pressure of demands, especially in coal and electric power.

In order to guarantee that energy production was adequate for the people's economic development the government cut back on capital construction, but at the same time sought every means to increase investment in energy construction, hasten construction on key projects, and adopt measures to support the energy industry. It is estimated that installed electric power capacity could reach 9 million kW this year, and newly added coal production capability could increase above 25,500,000 metric tons this year.

Under readjustment, the energy system has grasped the frail links in production by strengthening facility safeguards and new reforms, and by taking steps to reduce consumption.

China Now World's Fourth Largest Power Producer

916b0009a Beijing JINGJI RIBAO [ECONOMIC DAILY] in Chinese 7 Aug 90 p 1

[Article by reporter Xie Ranhao [6200 3544 3185]]

[text] "China's electric power industry has entered a new era of large units, high voltage, and large networks." These were the words of Zhang Fengxiang [1728 7685 4382], Director of China Electric Power Enterprise Federation, addressing reporters a few days ago on the state of the electric power industry.

Statistics show that, at present, China's installed power generation capacity is 124 million kW, up from 60 million kW in 1980, moving ahead of the world's fifth ranked country by 100 million kW. Annual generation capacity increased from 300.6 billion kWh in 1980 to 582 billion kWh, and now stands in fourth place in the world.

Zhang Fengxiang said,"Since the Seventh 5-Year Plan, electric power construction has accelerated, bringing on line each year an installed generating capacity of up to or near 10 million kW, and the proportion of large units among new units has increased. Now, the largest single unit capacity is up to 600,000 kW, and units of over 200,000 kW now make up nearly 40 percent of all installed thermal generator capacity throughout China, and there are now 13 thermoelectric plants of over one million KW installed capacity. At the same time, 500,000 volt extra high voltage transmission lines make up part of the primary transmission lines in China's power networks, and there are now 13 networks in China with an installed capacity of over 1 million kW.

It is also understood that since the Seventh 5-Year Plan, development of power system telecommunications and automatic grid switching has progressed. There are 18,000 km of microwave communications circuits serving cross-China power systems, and 605 microwave stations, one with its hub at Beijing that connects to Jiamusi in the north, Shenzhen in the south, east to Shanghai, and west to Xining, and the Longyangxia microwave network is also now under construction.

Li Peng Tells Power Enterprises To Become More Economical

916b0009b Beijing GUANGMING RIBAO in Chinese 18 Sep 90 p 1

[Article by reporter Zhang Chaowen [1728 6389 2429]]

[Excerpts] Premier of the State Council, Li Peng, said today that China's electric power enterprises must become more economical and conserve energy for the benefit of socialist modernization and construction. Today, in a speech given at Beijing's Shijingshan heat and power plant ribbon cutting ceremony, Premier Li Peng said,"I am an old employee of the North China Electric Power Administrative Bureau, one of the original participants in the Shijingshan heat and power plant project, an activist, and today, seeing this plant go into operation, and meeting with old comrades-in-arms and friends, I am especially pleased."

"We are in the process of socialist modernization and construction, and we want to realize our glorious strategic target of quadrupled gross value of production by the end of this century. We need to build even more power plants. We want to become more economical and conserve energy. We want to build more heat and power plants." [passage omitted]

The Shijingshan power plant was built in 1919. The installed capacity was 55,000 kW. It was the largest power plant in the Beijing area. The capacity was doubled over a period of 50 years, but was still far short of supplying the heat and power needs of Beijing. In 1983, with State Planning Commission approval, and investments by National Energy Investment Corporation, Beijing City, and China Energy and Electric Power Corporation, renovation of the old plant was undertaken to

equip it with three 200,000 kW thermal power units. Through his many years at the North China Electric Power Administrative Bureau, Li Peng gave special attention to this project, made numerous inspections, and gave it his direction. He personally decided to invite bids for this project to speed its construction. Once completed, the Shijingshan heat and power plant will perform a great service in relieving pressure for heat and electric power needs in the capital. [passage omitted]

Henan Forges Ahead in Energy Production

40100009a Beijing CHINA DAILY in English 19 Oct 90 p 1

[Text] Zhengzhou (Xinhua)—Henan Province in central China, which used to be famous for its vast expanse of fertile land and developed agriculture, has now become a major energy producer.

Last year, the province produced 88.58 million tons of coal, 9.53 million tons of crude oil and 1.3 billion cubic metres of natural gas, ranking second, fourth and second respectively among all the provinces in the country.

Meanwhile, the province generated 30 billion kilowatt-hours of electricity, which accounted for one third of the live wire entanglement capacity for central China.

Henan's energy industry has occupied a significant position in the economy of the province and has played an important role in the economic development of the whole country.

The province, one of the birthplaces of the Chinese nation, is rich in energy resources. The verified reserves of coal total 19.56 billion tons and those of crude oil amount to 600 million tons. There are also over 100 billion cubic metres of natural gas and associated gas in the area.

Historical records show that mining and use of coal in Henan dates back more than 2,000 years. However, in 1949, the time new China was founded, its total coal output was only 1.12 million tons.

In the past 41 years, the province's output of coal has increased at an average annual rate of 11 percent. Since 1980 in particular, the central and Henan provincial governments have made the development of the province's energy industry a top priority. As a result, 61 major coal, oil and electricity industry projects have recently been built, expanded or transformed. The total investment in these projects reached 13.2 billion yuan.

The province now has 40 big and medium-sized coal mines, each of which produces more than 600,000 tons of coal.

Two oil fields, namely the Zhongyuan Oil Field and the Henan Oil Field, have also been developed in the province. The Zhongyuan Oil Field alone produced 6.9 million tons of crude oil last year, ranking fourth among the country's oil fields.

Some oil refineries, including the Luoyang Refinery which has the capacity to refine five million tons of crude oil per year, fertilizer plants, as well as polypropylene, synthetic ammonia and urea plants that utilize oil products as raw materials, have also been built.

Meanwhile, 10 big and medium-sized thermal power plants with a total installed capacity of 4.32 million kilowatts, have been constructed, as have 100 smaller ones, each having a capacity of more than 500 kilowatts. The Yaomeng Power Plant, with an installed capacity of 1.2 million kilowatts, is one of the largest of its kind in the country. In addition, five more big and medium-sized power plants are still under construction. The province's electric energy production is now more than 4,000 times that of the early 1950s.

Last year, the province's annual output value for the energy industry amounted to 5.6 billion yuan, or 11.8 percent of its total industrial output value.

In the past 40 years, Henan Province has provided the State with 1.52 billion tons of coal. In recent years, it also has supplied other parts of the country with 20 million tons of coal annually.

Major Purchases of Power Generating Equipment Planned

40100014 Beijing CHINA DAILY (Business Weekly) in English 26 Nov 90 p 1

[Article by staff reporter Huang Xiang]

[Text] China will continue through the 1990s to make major purchases of electrical power generating equipment.

On the government's blueprint, a total of 120,000 megawatts of generating capacity will be installed in the next 10 years while domestic manufacturers can only supply the equipment to produce 10,000 megawatts a year.

"So China is still a big market for power equipment and technology such as major generating units," Zhang Shaoxian, president of North China United Power Company, told Business Weekly.

His company is in charge of one of the nation's leading power networks—a capacity of 16,646.6 megawatts.

His statement may have assured many foreign manufacturers and suppliers, whose confidence was tested recently by a debate in the Chinese press on generator imports.

Some in the industry, for instance, warned that if the industry continues its purchase of generating equipment at the present rate, most domestic firms will have to run at half capacity.

They said domestically-made units are comparable to imports in terms of major functions, servicing period and safety guarantees. And they are considerably cheaper than imports—an obvious advantage at present when China has started to service much of its growing foreign debt.

But others argue that a Chinese-made coal-fired unit consumes one third more coal than an imported one. And the loss may amount to 50 million tons of coal a year on a nationwide scale.

In the past decade, the nation imported 19,000 mw of generating equipment, or a quarter of the newly installed capacity in the period.

However, most agree that the nation's capacity to produce high quality large-capacity units is limited.

At present the industry is capable of manufacturing a dozen 300,000-kilowatt and four 600,000-kilowatt units a year, which the government expects to be the mainstay of generators in the near future.

According to Zhang, his company is planning to buy 300 megawatt or above complete sets of thermal power generating units and high water head and large capacity pumped storage generating units from overseas.

Other possible purchases will include 500 kilovolt transmission and substation equipment, dry type cables and several other items.

Since 1979, the North China United Power Company has spent $1.4 billion for purchases overseas which involve 19 sets of complete generating units with a total capacity of 4,330 mw.

Zhang disclosed that installed capacity in North China will increase from 15,000 mw to 30,000 mw in the next 10 years.

Currently the company is organizing an international exposition on power equipment and technology, which is scheduled to open next September.

Speeding Up the Cascade Development of the Qing Jiang

906B0106 Beijing SHUILI FADIAN [WATER POWER] in Chinese No 7, 12 Jul 90 pp 6-8, 24

[Article by Guo Jikang [6753 7139 1660] of the Hubei Province Qing Jiang Development Company: "Adhere to Industrial Policy in the Energy Resource Industry, Accelerate Continued Cascade Development of the Qing Jiang"]

[Text] In 1989, the Ministry of Energy Resources formulated and issued its "Industrial Policy Implementation Methods (Trial) for the Energy Resource Industry" which made hydropower development an industrial development sequence for key support. This was extremely gratifying. Still, what worries everyone even today is the inadequate unity of people's understanding of the status and role of hydropower in the energy resource and electric power industries and the failure to sufficiently perfect principles and policies for focused support of hydropower development. I will start with the characteristics of energy resources in Hubei Province to discuss some questions regarding preferential development of the hydropower "motherlode" in the near and medium terms.

I. We Must Fully Understand the Characteristics of Energy Resources in Hubei Province and Establish Principles for Preferential Development of Hydropower in the Near and Medium Terms

Hubei Province's energy resources have three main characteristics:

1. It is relatively poor in mineral energy resources and production capabilities are rather low. According to the relevant information and statistics, Hubei has proven coal reserves of 651 million tons, less than 0.1 percent of China's total reserves. The present annual coal production capacity is 8 million tons and estimates indicate that 15 to 20 million yuan will have to be invested each year from 1990 to 2000 to sustain yearly output at the 7.6 to 8 million tons level. Hubei has proven petroleum reserves of 62.58 million tons and its present yearly crude oil production capacity is 1 million tons. Forecasts indicate that this level can be sustained until 2000. In Hubei's final energy resource consumption structure in 1986, coal was 23,742,100 tons, accounting for 55.6 percent, and the province's self-sufficiency rate was just 35.1 percent. Petroleum was 3,343,600 tons, accounting for 15.2 percent, and the province's self-sufficiency rate was just 30.8 percent. Consumption of other gas fuels, electric power, heat, and other energy resources accounted for 29.2 percent.

2. For shipping coal from north to south China, railway transport capacity is limited. The coal used in Hubei Province mainly relies on supplementing by "shipping coal from north to south China", especially for the coal used for thermal power generation, which comes from Shanxi, Shaanxi, and Henan provinces. According to statistics, Hubei Province ships in an average of more than 20 million tons of coal each year, one-fourth of it used for thermal power generation. Hubei can only rely on the Jing-Guang [Beijing-Guangdong] and Jiao-Zhi [Jiaozuo-Zhicheng] Railroads to "ship coal from north to south China". The transport capacity of both of these railroads is now saturated. The Xinyang to Guangshui section and Wuhan Chang Jiang bridge on the Jing-Guang railroad are now restricted by hauling capacity. The annual freight volume south of Xinyang is 36 million tons, 68 percent or 25 million tons of it coal. The amount of coal shipped to Hubei is 15 to 16 million tons and about 10 million tons of coal crosses the border. The yearly volume of freight shipped into the Xiangfan region on the Jiao-Zhi line is 9.8 million tons, 46.62 percent or about 4.57 million tons of it coal. For the past several years, because of railway transport shortages, the coal included in plans for state allocation to Hubei to be burned to generate power often cannot be shipped in the specified amounts and shipped to the various power plants on schedule. In 1988, the arrival rate for coal was just 85 percent, so 400 to 500 MW of thermal power generators in Hubei had to be shut down during the winter and spring while waiting for coal and could not provide their necessary benefits during the dry season. After completion of a group of thermal power plants at Hanchuan, Ezhou, and Yangluo in eastern Hubei in recent years, there will be a several-fold increase in the amount of coal used to generate power in Hubei Province.

3. Abundant hydropower resources, superior development conditions. Besides the Chang Jiang, Hubei Province has over 1,000 medium-sized and small rivers, most of them mountain rivers with steep riverbeds and large heads. Added to the ample precipitation, our hydropower resources are rather abundant. According to survey information, Hubei holds sixth place in China in developable hydropower resources. Moreover, the development conditions are superior and there are many excellent sites for large and medium-sized hydropower stations that could permit cascade development of river basins at a low unit construction cost per kW. The inundation losses would not be great, the rivers have a low silt content, the technical economics indices are excellent, the power source sites are suitably concentrated, and the power supply economics and other characteristics are excellent. The present installed hydropower generating capacity in Hubei Province is 4,470 MW, just 15.7 percent of its developable resources. The remaining large amount of hydropower resources are just flowing away unused. They are equivalent to losing 62.5 million tons of coal each year.

Because Hubei Province is rather poor in mineral energy resources, our railroad transport is inadequate, and water-borne transport on the Chang Jiang is not being fully utilized, the rate of thermal power development in Hubei is lower than in other provinces. Yearly power output at the end of 1988 was just 8.8 billion kWh, only one-fourth of total yearly power output in Hubei Province. Analysis of Hubei's energy resources shows that

readjustment of Hubei's present energy resource industry structure, shifting toward preferential development of hydropower, and appropriate development of thermal power in the load centers of eastern Hubei should be an important principle for energy resource industry construction in Hubei.

II. We Must Correctly Assess the Benefits of Investing in Hydropower and Have Firm Confidence in Preferential Development of Hydropower

For a long time, we have placed the three hats of "large investments, long construction schedules, and inundation of large amounts of land by reservoirs" on hydropower construction and used this to determine that the results of hydropower construction are poor. Under the influence of this sort of bias, the extent of development and utilization of Hubei's abundant hydropower resources is lower than in the developed nations of the world as well as lower than many developing nations. For the past several years, faced with a serious energy resource situation, people have been pondering and exploring and many experts and scholars have called for removing the three hats from hydropower construction. The key is scientifically assessing hydropower.

1. On hydropower construction investments. Hydropower engineering is an optimum industry for "combining three into one" for electric power construction, coal mine construction, and railroad construction. Its construction investments include hydraulic structure expenditures, electrical equipment expenditures, funds to compensate for reservoir inundation losses, funds to improve shipping, expenditures for transmitting electric power to outside areas, and so on. Thermal power plant construction is also a form of systems engineering and must include everything from the power plant itself to coal base areas, railway transport, environmental protection, and so on. Thus, thermal power plant construction investments should include expenditures on civil engineering for the thermal power plant, expenditures on electromechanical equipment, expenditures on coal base area construction, expenditures on railroad construction, expenditures on environmental protection, expenditures to transmit electric power to outside areas, and so on. Analysis of the relevant information indicates that the unit investment at present for a 200 to 300 MW thermal power generator is about 1,700 yuan per kW. Adding the matching expenditures listed above, the unit investment is more than 4,000 yuan per kW, which is 1.3 to 1.5 times higher than the unit investment per kW to build large hydropower stations. Moreover, the operating expenses of a thermal power plant after it goes into operation are much higher than hydropower.

2. On hydropower construction schedules. Hydropower construction has an inherently rational construction schedule. This is an objective fact, but when people are comparing the length of construction schedules for thermal power and hydropower they ignore construction schedules for coal mine construction and railroad construction that are associated with thermal power. If these indispensable construction schedules in thermal power construction are combined, there is no doubt that they are somewhat longer than hydropower construction schedules. An accurate comparison must be made using an identical baseline and similar hydropower stations. Just as we cannot compare the construction schedule for a nuclear power plant with the construction schedule for a hydropower station and refuse to build nuclear power plants, we cannot use the construction schedule for thermal power plants as a reason for refusing to build hydropower stations.

3. On the inundation of land by reservoirs at hydropower stations. For the question of land inundation by reservoirs, there must be comprehensive analysis and comparison of overall benefits. First, we must consider the inundation of land by a reservoir, but we also must take note of using the reservoir to irrigate land and reducing flooding and waterlogging of land. Usually, the area irrigated is larger than the area inundated. At the Dan Jiang Mouth Reservoir, for example, several 100,000 mu of land were inundated but it can add 1 million mu of farmland to the lower reaches of the Han Shui. Second, we must consider the reduction in the cropping area from inundation of land in the reservoir region, but we also must consider the water area formed by the reservoir and the increase in breeding area. Third, consideration also must be given to the water-borne transport capacity formed in the reservoir region compared to the area of land used to build a railroad with a similar freight capacity.

4. On the question of the ecological environment. Along with development of energy resources, hydropower construction also can protect greening of nature and purification of the atmosphere, so it does not damage the natural environment. Thermal power, on the other hand, discharges carbon dioxide, sulfur dioxide, hydrocarbons, and other toxic gases and particulates during the production process and seriously pollutes the environment. In the Wuhan region where the Qing Shan Heat and Power Cogeneration Plant is located, for example, the atmospheric concentration of sulfur dioxide is 0.5 mg/m^3, settling particulates are 40 to 100 tons/month, and fly ash concentrations are as high as 160 to 400 $\mu g/m^3$ per square kilometer, which greatly exceed the internationally stipulated environmental standards (the international standard is $SO_2 \leq 0.15 mg/m^3$, settling particulates $\leq$6-8 tons/month/km^2, and fly ash $\leq 75 \mu g/m^3$). In a trial comparison, if three cascade hydropower stations were developed on the trunk of Qing Jiang with an installed generating capacity of 2,900 MW and yearly power output of 8.5 billion kWh, this would be equivalent to the production capacity of two 1,000 MW thermal power plants, and the thermal power plants would have to consume 5 million tons of coal to generate 8.5 billion kWh of power. Projections indicate that if the ash content of this 5 million tons of raw coal was 30 percent, it would generate 1.5 million tons of coal ash each year and even if the ash removal rate were 95 percent it would still discharge 75,000 tons of particulates into the atmosphere. If this 5 million tons of raw coal contained

100,000 tons of sulfur dioxide and other oxides which were also discharged into the atmosphere, it would have extremely serious effects on the environment. Hydropower, on the other hand, is a non-polluting clean energy resource and construction of three cascade hydropower stations on the Qing Jiang would have no effects on the ecological environment. A thermal power plant cannot be compared with this social benefit.

III. Borrow From the Experiences of Foreign Countries, Give Preference to Developing Hydropower Resources, Take the Route to a Strong Nation and Prosperous People

None of the world's economic powers at the present time has failed to develop its electric power industry and they have common experiences in developing their electric power industries: 1) They have determined principles for developing power based on the energy resource characteristics of each country; 2) During the process of developing electric power, all of them which had hydropower resources gave preference to developing hydropower; 3) Different forms of large power grids must be formed for each type of power generation energy resource to obtain the best economic benefits.

In the nations of the world with rather high proportions of hydropower like Norway, which had an installed hydropower generating capacity of 17,530 MW and generated 81 billion kWh of power each year as early as 1978, power generated by hydropower accounts for 99.8 percent of the total power output of the country and their hydropower resources are being fully utilized. During the process of developing electric power in other countries like Japan, Italy, Spain, and so on, hydropower has accounted for an 80 to 90 percent proportion of total power output in these countries. Only later, because nearly all of their hydropower resources had been developed, did they develop power generation using thermal power and atomic energy and their proportion of hydropower declined. Hydropower also occupies the dominant position in regional grids in many countries. During the process of developing hydropower in countries and regions which have a rather large proportion of hydropower, they also encountered problems like long-distance transmission of electric power, grid stability, seasonal electric power output, peak regulation and frequency regulation, and so on, all of which were resolved through practice. Hubei Province has 24,815 MW of developable hydropower resources that could generate 124.89 billion kWh of power annually, sixth place in China. Our abundant hydropower resources are the bedrock for invigorating Hubei's economy and achieving a rise in central China. In the annals of power development in Hubei, hydropower got started rather late. In the winter of 1955, to welcome the First Hubei Province Peasants Conference, a small hydropower station with a capacity of 26 kW was built in Chongyang County. After 35 years of arduous efforts, Hubei's total installed hydropower generating capacity grew to 4,470 MW, equal to 15.7 percent of Hubei's total developable capacity. Hydropower generated about 25 billion kWh of power in 1989, equal to 76 percent of total power output in Hubei. Hubei Province now holds first place in China in installed generating capacity and yearly power output from hydropower. The hydropower resources that Hubei has already developed can conserve about 15.60 million tons of coal each year, double the amount of coal produced annually in Hubei. Thus, developing hydropower is a route to a strong nation and prosperous people. Hubei still has a serious power shortage and must shut off power an average of 200 times a day. Insufficient electric power has now become one of the main factors restricting growth of Hubei's economy. During the era of economic improvement and rectification, we should readjust the industrial structure and electric power industry structure, and give preference to developing hydropower.

IV. Qing Jiang Is a "Motherlode" of Hydropower Resources and Preference Should Be Given to Developing the Entire Basin

According to projections by the relevant departments and calculating the average yearly increase in power use levels in Hubei at 8.6 percent, Hubei will need 45 billion kWh of power and 8,170 MW in electric power in 1995, and will have a power shortage of 2.4 billion kWh. If startup of Geheyan, Hanchuan, and other major power source points scheduled for operationalization during the Eighth 5-Year Plan to balance electric power and power output is delayed, the power shortage will be even more serious. If Hubei wants to achieve the goals of invigoration and a "rise in central China", we must give preference to developing hydropower. This is the trend of the times and cannot be delayed. Starting with existing construction conditions, we should give preference to developing hydropower on the Qing Jiang, focus on building Geheyan and Gaobazhou, and move ahead with Shuibuya.

The Qing Jiang is one of the richest in hydropower resources among the more than 700 tributaries of the Chang Jiang. Its trunk is 423 kilometers long, it is the main river in southwest Hubei, its basin covers an area of 17,000 km^2, the perennial average precipitation is 1,400 mm, the perennial average runoff is 12.7 billion m^3, and the trunk has a total head of 1,430 meters. Because the entire Qing Jiang basin is located within Hubei Province, the head of its trunk is large, and it has abundant rainfall, abundant hydraulic resources, and rather convenient communications, it is a hard-to-come-by river for cascade development. Several decades of exploration by the Chang Jiang Basin Planning Office indicate that the basin as a whole has a developable installed hydropower generating capacity of 3,291 MW and can generate 10.51 billion kWh of power annually. This includes a three-cascade power station development program on the trunk at Shuibuya, Geheyan, and Gaobazhou with a total installed generating capacity of 2,900 MW and yearly power output of 8.49 billion kWh. After the hydropower resources of the entire basin are developed, the hydropower utilization

rate will be rather high and the amount of water consumed per kWh will be 1.4 m^3. This includes water consumption of 4.17 m^3 per kWh for Geheyan Hydropower Station, which will be developed and placed into operation first, and it will still be the leader among the large and medium-sized hydropower stations that Hubei has already developed. After the hydropower resources of the Qing Jiang are developed, they will be able to provide 2,700 MW in peak regulation capacity and they will provide 3,290 MW of electric power to the entire basin. Vessels of the 300-ton grade will be able to sail directly into the Chang Jiang and yearly shipping capacity in both directions will be 3 million tons. Yearly power output will be 10.5 billion kWh, equivalent to conserving 6.3 million tons of coal burned to generate power. They will create 32.55 billion yuan in social value of industrial output and create 4,882,500,000 yuan in output value profits and taxes (calculated at 15 percent), so their economic and social benefits will be enormous.

V. We Should Intensify Reform To Provide New Avenues for Policies and Explore Ways To Accelerate Basin Development

The flow was blocked 1 year ahead of schedule at Geheyan Hydropower Station on the Qing Jiang and it has now entered the major construction stage. However, construction of the project has consistently faced serious construction capital shortages and other problems since the last half of 1988 and the capital shortage has also delayed progress in preparatory work to develop other cascade power stations in the basin. The 3-year period between 1990 and 1992 is one of improvement, rectification, and reducing the scale of construction. In this 3-year period, whether or not development of Geheyan Hydropower Station and the entire Qing Jiang basin continues to be in a difficult position of insufficient capital is a major question that should receive a high degree of attention from all areas. We feel that there are ways to accelerate development of the Qing Jiang basin. This route is to adhere to the principle of reform and implement new policies that benefit the development of hydropower itself. These new policies mainly involve:

1. Implement slanted policies. The state should increase the proportion of its investments in hydropower.

2. Implement a policy of "using power to develop power". When the state invests money in construction of the first power station, after it goes into operation all of the profits should be used to develop other cascades in the basin for rolling development in a benevolent cycle.

3. Implement policies for independent accounting for newly built hydropower stations. The relationship between power stations and grids is one of selling electricity, independent administration, responsibility for their own profits and losses, and self-development.

4. Implement policies providing for new policies for new power to give units which build and manage power stations sufficient loan repayment capabilities.

5. The electric power construction fund requisitioned from the power generated by hydropower should be "fixed" and continue to be used to develop hydropower.

6. Raise capital from a wide range of sources, use it for preferential development of hydropower.

Of course, implementation of these new policies touches upon a broad range of areas and is rather difficult. However, if we have a profound understanding of China's hydropower resource advantages, make accelerated hydropower construction a basic strategy in China's energy resource industry, truly focus on supporting hydropower development in intensified reform, improvement and rectification, and readjustment of structures, and readjust investment, pricing, financial, taxation, credit, and several other policies, it will be possible for China's hydropower industry to achieve sustained, stable, and coordinated development.

Building a Hydropower Energy Base in Southwest China

906B0093 Beijing SHUILI SHUIDIAN JISHU [WATER RESOURCES AND HYDROPOWER ENGINEERING] in Chinese No 6, 20 Jun 90 pp 2-7

[Article by Liang Yihua [2733 4135 5478] of the China Hydropower Engineering Society: "Take Advantage of Hydropower Resources To Develop the Southwest China Hydropower Base Area"]

[Text]

I. Rational Utilization of Hydropower Resources Is an Important Strategic Question

Resources are an important issue which the world is extremely concerned with at the present time and they are the key question in China's modernization and construction. Our shortages of resources and electric power are already severely restricting development of our national economy and improvements in people's living standards. Forecasts indicate that there will be a substantial shortage of primary energy resources by the year 2000, but a deciding factor for China's modernization prospects is sufficient supplies and rational utilization of energy resources. For this reason, we must begin with China's national conditions, rely on scientific and technological progress, formulate correct energy resource development and utilization principles and policies, increase development of primary energy resources, improve the structure of primary energy resources, and rationally utilize and conserve energy resources.

China has relatively abundant energy resources and relatively large total amounts. We have proven reserves of 859.4 billion tons of coal, 12.6 billion tons of petroleum, and 865.8 billion cubic meters of natural gas, and 378,000 MW of developable hydropower resources. Our per capita amounts are not large, however, and they are very unevenly distributed, with 64 percent of our coal in north China and 70 percent of our hydropower resources

in southwest China. China's extractable reserves of coal, petroleum, natural gas, and other fossil energy resources are third in the world, following only the United States and the Soviet Union, but our per capita amounts are 1/9th those of the United States and Soviet Union and one-half those of the world. We are first in the world in hydropower resources but our per capita amounts are just two-thirds of the world levels. Since the 3d Plenum of the 11th CPC Central Committee the party and government have been extremely concerned with energy issues and have made energy resources a strategic focus for economic and social development. They have expended a great deal of effort on energy resource production and construction and achieved stable development. By 1989, total output of primary energy resources in China had reached 1 billion tons of standard coal, including 1.04 billion tons of raw coal output, 137.6 million tons of crude oil output, 14.4 billion cubic meters of natural gas, and power output of 580 billion kWh, including 116 billion kWh from hydropower. Development of coal in Shanxi and Inner Mongolia has turned them into China's coal and thermal power energy resource base area and they are now playing an increasingly important role. Still, however, there has been no basic solution of the energy shortage. Increased demand for coal has created substantial pressure on transport and it causes severe environmental pollution, which has become a major social problem. To achieve the goals of the third step, attaining levels of moderately developed countries by the middle of the next century, there must be substantial development of primary energy resources and electric power. Based on China's energy resource structure, major strategic questions that we now face are how to rationally utilize energy resources, protect the ecological environment, and meet the needs of national economic development and relative prosperity in the people's living standards.

Among primary energy resources, hydropower is a renewable and clean energy resource. The experience of most nations of the world in energy resource development and utilization is that they gave primacy to developing and utilizing hydropower energy resources. Calculated on the basis of annual power generation from developable energy resources, the world as a whole has now developed over 20 percent and the developed nations more than 40 percent. The figure is more than 90 percent in Switzerland, France, Italy, and England, 21 percent in the Soviet Union, and 19 percent in India, but China has developed only 6 percent, so we lag far behind both the developed nations and India and other developing nations. For this reason, many people have pointed out that China has had a power shortage for a long time and we have abundant hydropower resources, so why have we not developed and utilized more of them? Even Sichuan Province, which has rich concentrations of hydropower resources, is making major efforts to develop thermal power, which has created coal shortages and forced them to import coal from other provinces. This is placing substantial pressures on railway transport, which was already in short supply, and it is causing further degradation of the atmospheric environment, which cannot be understood. I feel that the main factor which created this type of situation is an inadequate understanding of renewable energy resources and their status and role in development of the national economy which has led to errors in energy resource development strategies and mistakes in state investment policies. Another thing is irrational electricity prices and taxation policies which have affected development of the electric power industry and prevented the advantages of hydropower from being revealed. Defects in the electric power management system are not conducive to development of the hydropower industry. There are no resource exploration funds for primary energy resources allocated to hydropower like they are for coal and petroleum, which has severely affected progress in preparatory work and reserve projects. For this reason, the China Hydroelectric Power Engineering Society feels that it is very necessary to do surveys and research on hydropower development strategies, integrate hydropower development with development and utilization of all energy resources, development of the electric power industry, comprehensive utilization of water resources, territorial administration, and regional economic development, raise it to strategic heights for consideration, and explain its status and role in development of the national economy so that more people understand the advantages of hydropower to promote the development of hydropower resources, improve the primary energy resource structure, make this a focal task of the China Hydroelectric Power Engineering Society, and undertake survey inspections and research. In the past 4 years, the Hydropower Society has joined with the China Energy Resource Research Society, China Territorial Economics Research Society, and the China Water Resources Research Society in conjunction with the relevant provinces (autonomous regions) to organize comprehensive examination and research on hydropower economics for the upper reaches of the Huang He, Wu Jiang, Lancang Jiang, and Sichuan's "Three Rivers" (Jinsha Jiang, Yalong Jiang, and Dadu He) and deepened our understanding of rational development of hydropower resources. We have consistently felt that besides adapting to local conditions to accelerate development of hydropower resources in all regions, we should study fostering China's hydropower resource advantages, establish a hydropower resource base area in southwest China similar to the construction of north Shanxi and Inner Mongolia into China's coal and thermal power resource base area, and make an important contribution to development of the national economy.

II. Resource Advantages of China's Three Southwestern Provinces

Yunnan, Guizhou, and Sichuan provinces in southwest China have developable hydropower resources that could produce 975 billion kWh of power a year, equal to 50.7 percent of the total for China. They have 75.52 billion tons of coal resource reserves, 13 percent of the

total for China. They account for 26 percent of China's developable primary resources, second only to north China.

The energy advantages of each province are outlined below:

A. Yunnan Province

1. Hydropower resources

The developable installed generating capacity is 71,168 MW for yearly power output of 394.45 billion kWh, equal to 20.5 percent of China's total developable hydropower resources, second only to Sichuan among all of China's provinces (and autonomous regions). Yunnan's energy resources are concentrated in a "motherlode" and have superior development conditions. In the middle and lower reaches of Lancang Jiang, for example, eight cascade power stations could have an installed generating capacity of 13,700 MW and generate 70.8 billion kWh of power annually (see Table 1). On the trunk of Jinsha Jiang, 18 cascades could have an installed generating capacity of 57,047 MW and generate 302.8 billion kWh of power annually (see Table 2). This includes 6,730 MW of medium-sized hydropower resources which could generate 36.1 billion kWh of power annually.

2. Coal resources

Yunnan Province has total coal reserves of 17.7 billion tons, ninth place in China, and prospective reserves of 70 billion tons that have a concentrated distribution. They include lignite, most of which is buried at shallow depths, has a small stripping ratio, and can be extracted through strip mining, so it is suitable for building large thermal power plants.

The distance for transmitting power to both central and east China is about 1,400 kilometers.

Table 1. Primary Indices for Cascade Power Stations in the Middle and Lower Reaches of Lancang Jiang

Name of cascade	Perennial average flow (billion m^3)	Water obstruction height (m)	Normal water storage level (m)	Total reservoir capacity (billion m^3)	Effective reservoir capacity (billion m^3)	Installed generating capacity (independent/joint) (MW)	Guaranteed output (independent/joint) (MW)	Yearly power output (independent/joint) (billion kWh)
Gongguoqiao	31.06	77	1,319	.51	.12	750/750	170/38 9.5	4.063/4.063
Xiaowan	38.47	248	1,236	14.55	9.8	3,600/3,600	1,740/1 7,651	18.207/17.458
Manwan	38.79	99	994	.92	.258	1,250/1,500	314/796.1	6.71/7.884
Dazhaoshan	42.26	80	895	.96	.24	1,000/1,250	276/680	5.5/6.5
Nuozhadu	55.19	205	807	22.7	12.4	4,500/4,500	2,100/23 ,221	22.396/23.107
Jinghong	50.83	67	602	1.04	.23	900/1,350	300/764.9	5.57/7.686
Ganlanba	59.29	10	533	-	-	100/150	27/78.4	.587/.77 7
Nan'a He mouth	63.7	28	519	-	-	400/600	112/336.6	2.417/3.383
Total				46.08	23.048	12,500/13,700	5,039/7,133	65 .45/70.86

Table 2. Primary Indices for Cascade Power Stations on the Trunk of Jinsha Jiang

Name of cascade	Normal water storage level (m)	Utilized head (m)	Total reservoir capacity (billion m^3)	Effective reservoir capacity (billion m^3)	Installed generating capacity (MW)	Guaranteed output (MW)	Yearly power output (billion kWh)
Dongjiula	3,530	74	.195	.12	160.5	40.1	.903
Shaila	3,440	80	.170	.100	176.8	43.7	.997
E'nan	3,360	150	3.1	1.2	600	180	2.6
Baili	3,210	200	8.5	2.7	1,006	360	4.8
Jiangqu He mouth	3,010	290	7.6	1.2	2,200	710	13.3
Batang	2,720	200	3.7	.85	1,300	420	8.1
Wangdalong	2,520	160	14.1	4.1	2,000	620	8.7
Baimian	2,300	200	3.8	1.2	1,800	530	10.6

Table 2. Primary Indices for Cascade Power Stations on the Trunk of Jinsha Jiang (Continued)

Name of cascade	Normal water storage level (m)	Utilized head (m)	Total reservoir capacity (billion m^3)	Effective reservoir capacity (billion m^3)	Installed generating capacity (MW)	Guaranteed output (MW)	Yearly power output (billion kWh)
Tuoding	2,100	150	5.9	2.1	2,500	670	13.1
Hutiao Gorge	1,950	344	18.16	10.61	6,000	2,870	10.29
Hongmenkou	1,600	206	6.72	3.54	3,750	1,180	18.79
Zili	1,400	117	1.49	.49	2,080	490	10.59
Pichang	1,280	136	8.82	2.79	2,700	800	13.65
Guanyinyan	1,150	140	5.42	2.17	2,800	780	14.33
Wudongde	950	144	4	1.6	4,600	1,400	25
Baihetan	820	227	19.5	9.3	8,300	3,250	45.7
Xiluodu	600	226	12.06	6.62	10.080	3,460	53.18
Xiangjiaba	380	112	4.772(5.06)	1	5,000	1,400	28.2
Total		3,156	128.007		570.473	19,203.8	302.81

Note: All the indices above are for independent operation and include four cascades below Panzhihua City which were considered only for joint operation with Ertan Hydropower Station.

B. Guizhou Province

1. Hydropower resources

The developable installed generating capacity is 13,250 MW for yearly power output of 65.24 billion kWh, seventh place among all of China's provinces (and autonomous regions). It is mainly concentrated on the trunk and tributaries of Wu Jiang, with 8,340 MW and yearly power output of 41.57 billion kWh, including an installed generating capacity of 6,400 MW on nine cascades on the trunk of Wu Jiang within Guizhou Province (see Table 3) which have the advantages of inundating little land and requiring resettlement of few people, an appropriate scale, investment savings, and short construction schedules. They include 3,520 MW in medium-scale hydropower resources with yearly output of 17.8 billion kWh.

2. Coal resources

Guizhou Province as a whole has reserves of 48.86 billion tons, fourth place in China, and it has the richest concentration of reserves of the provinces of south China. Construction of Liupan Shui Coal Base Area has already attained a substantial scale.

Combined development of Guizhou Province's coal and hydropower resources would turn it into a powerful electric power resource base area, and it is the region of the southwest China hydropower resource base area that has the shortest power transmission distance to south and central China.

Table 3. Primary Indices for Cascade Power Stations on the Trunk of Wu Jiang

Name of cascade	Perennial average flow (m^3/s)	Normal water storage level (m)	Regulation flow rate (m^3/s)	Total reservoir capacity (billion m^3)	Effective reservoir capacity (billion m^3)	Guaranteed output (MW)	Installed generating capacity (MW)	Yearly power output (billion kWh)
Puding	129	1,145	40.3	.362	.282	17	75	.38
Yinzidu	152	1,088	50.4	.543	.397	40	160	.83
Hongjiadu	152	1,140	139	4.589	3.223	165	540	1.54
Dongfeng	355	970	110	.863	.490	110	510	2.42
Suofengying	427	835	81.6	.157	.085	48	200	1.23
Wujiangdu (at present)	511	760	193	2.14	1.35	202	630	3.34
(after expansion)						387	1,050	
Goupitan	742	630	398	5.69	3.66	585	2,000	9.09
Silin	863	440	230	.621	.095	135	840	3.66
Shatuo	953	360	227	.38	.204	125	800	3.67

Table 3. Primary Indices for Cascade Power Stations on the Trunk of Wu Jiang (Continued)

Name of cascade	Perennial average flow (m^3/s)	Normal water storage level (m)	Regulation flow rate (m^3/s)	Total reservoir capacity (billion m^3)	Effective reservoir capacity (billion m^3)	Guaranteed output (MW)	Installed generating capacity (MW)	Yearly power output (billion kWh)
Pengshui	1,320	293	298(290)	.560	.213	211	1,200	6.27
Daxikou	1,640	210	321	.161	.161	160	800	4.75
Total				18.41	11.21	1,798	7,755	37.18

Note: All indices in this table are for independent operation.

C. Sichuan Province

1. Hydropower resources

The developable installed generating capacity is 91,660 MW for yearly power output of 515.3 billion kWh, equal to 26.8 percent of all of China's developable hydropower resources and first place among all the provinces (autonomous regions) in China. Hydropower accounts for 76.7 percent of Sichuan Province's total energy resource structure and it has the richest concentration of hydropower resources in China. Moreover, most of the hydropower stations have superior development conditions: concentrated heads, large drops, abundant flows, small inundation losses, and good power economics characteristics, especially the cascade power stations on Yalong Jiang, Jinsha Jiang, and Dadu He. Below Lianghekou [Two River Mouths] on the trunk of Yalong Jiang, for example, there are 11 cascades which could have an installed generating capacity of 19,400 MW and yearly power output of 109.29 billion kWh (see Table 4). The 16 cascades on the trunk of Dadu He below Dusong could have an installed generating capacity of 17,600 MW and yearly power output of 100.8 billion kWh (see Table 5). These include 14,340 MW in medium-scale hydropower resources for yearly power output of 80.9 billion kWh.

2. Coal resources

Sichuan has total coal reserves of 8.96 billion tons, which is relatively insufficient, and it is a coal-poor province.

3. Natural gas resources

Prospective reserves could be as much as 750 million m^3 [as published] and there are excellent development prospects. It has 239.5 billion m^3 of proven reserves, equal to 27.6 percent of China's total proven reserves, and it holds first place among all of China's provinces (and autonomous regions). It has preserved reserves of 138.2 billion m^3.

Table 4. Primary Indices for Cascade Power Stations Below Lianghekou [Two River Mouths] on Yalong Jiang

Name of cascade	Perennial average flow (m^3/s)	Normal water storage level (m)	Total reservoir capacity (billion m^3)	Effective reservoir capacity (billion m^3)	Installed generating capacity (MW)	Guaranteed output (MW)	Yearly power output (billion kWh)	Maximum head/Minimum head (m)
Lianghekou	668	2,913	8.4	5.0	2,000	980	10.7	240/160
Yagen	765	2,673	.73	.5	900	221	4.75	135/85
Menggushan	856	2,538	.85	.6	1,600	390	8.45	193/133
Dakong	882	2,345	-	-	1,000	210	5.4	127/
Yangfanggou	912	2,218	2	1.35	2,000	480	10.4	205/145
Kalaxiang	929	2,013	-	-	800	160	4.4	98/
Jinping first cascade (behind dam)	1,240	1,900	10.0	6.0	3,000	1,450	18.19	265/183
Jinping second cascade (water diversion)	1,240	1,637	-	-	3,000	1,900*	21.0	309/270
Guandi	1,470	1,324	-	-	1,400	280	6.7	99/
Ertan	1,670	1,200	5.8	3.37	3,300	1,000	17.0	188/136
Tongzilin	1,870	1,015	.072	.03	400	100	2.3	28/18
Total					19,400	10,929		

* Is the guaranteed output for the Jinping first cascade. All other cascades are the guaranteed output and power output during independent operation.

Table 5. Primary Indices for Cascade Power Stations Below Dusong on the Trunk of Dadu He

Name of cascade	Perennial average flow (m^3/s)	Normal water storage level (m)	Total reservoir capacity (billion m^3)	Effective reservoir capacity (billion m^3)	Utilized head (m)	Guaranteed output (independent/joint) (MW)	Installed generating capacity (MW)	Yearly power output (independent/joint) (billion kWh)
Dusong	513	2,310	4.96	2.68	213	500/532	1,360	6.84/ 7.01
Mana	550	2,092	.17	.02	52	53/31.9	300	1.6/1.81
Lijia He Dam	727	2,040	2.0	-	240	348/786	1,800	9.58/10.96
Houziyan	778	1,800	-	-	170	271/582	1,400	7.39/8.35
Chang He Dam	815	1,630	.6	-	155	255/532	1,240	6.8/7.62
Lengzhuguan	890	1,475	.62	-	105	185/393	900	4.91/5 .54
Huyun	890	1,370	.28	-	70	123/261	600	3.28/3.69
Yingliangbao	890	1,250	-	-	120	214/439	1,100	5.83/ 6.55
Dagang Shan	1,060	1,100	.45	.15	145	343/594	1,500	8.12/8.97
Longshitou	1,060	955	.12	.02	50	114/232	500	2.80/3 .13
Laoyingyan	1,130	905	-	-	50	127/233	600	3.19/3.50
Baobugou	1,340	850	5.25	.387	179	882/1,055	2,800	1 4.15/14.28
Shenxigou	1,340	650	-	-	27	79/194	360	1.98/2.34
Zhentou Dam	1,340	623	-	-	33	97/237	440	2.41/2.87
Gongzui	1,490	590	1.88	.82	116	432/834	2,100	10.10 /10.48
Tongjiezi	1,490	474	.20	.054	41	130/332	600	3.21/3 .71
Total					1,771	4,153/7,375	17,600	92.19/100.81

III. Strategies and Measures for Building the Southwest China Hydropower Resource Base Area

The three provinces are relatively rich in energy resources but the degree of development is very low. Their output of primary energy resources at the end of 1988 was just 103 million tons of standard coal, less than 0.2 percent of their developable energy resources. They generated just 23 billion kWh of electricity from hydropower, 2.4 percent of the yearly output from developable hydropower resources. It is evident that the hydropower resources of China's three southwestern provinces occupy an important strategic status in China's energy resources and there is great potential for development. After a comprehensive inspection of hydropower on Sichuan's "Three Rivers" in 1989, we suggested construction of the southwest China hydropower resource base area in the report we submitted to leading comrades in the CPC Central Committee and State Council. Construction of a hydropower resource base area in the three provinces of southwest China to take full advantage of their hydropower resources is very important for alleviating the energy resource and electric power shortages in southern China. It also would play an inestimable role in industrial and agricultural development and regional invigoration in the southwest China region and could transmit power to eastern China and compensate for the region's shortages. In China's national energy resource system and the energy resource base area centered on Shanxi, it will be a mutual corner, work in concert with south and north China, foster advantages and compensate for disadvantages, improve the energy resource structure, promote balance in energy resources, readjust the deployment of energy resources, and optimize the results of utilization.

This proposal has received attention from the relevant departments. However, how to build the southwest China energy resource base area is an extremely complex question that involves large-scale systems engineering. A joint committee of the Ministry of Energy Resources and China's electric power enterprises has now included "research on strategies for building the southwest China energy resource base area" among soft science research topics and the China Hydropower Engineering Society has been entrusted with organizing the relevant units and experts in the three provinces to conduct the research. The research topic plan has offered these preliminary viewpoints:

A. Guiding ideology of the research topic

Construction of the southwest China energy resource base area should be centered on economic construction and adhere to the overall principle of "reform and opening up". Development of hydropower resources should help promote readjustment of the regional industrial structure and comprehensive development of the

region's economy. It should be concerned with deployment of China's economy and energy resources and try to meet the needs of the national economy for energy resources, electric power, and high power load commodities. It also should satisfy demand for energy resources and rational configuration of the forces of production in the region itself, readjust the local industrial structure, and achieve comprehensive development of the economy of the three provinces and greater improvements in the people's standard of living.

When studying development of hydropower resources, the first thing is to start with planning and deployment of China's entire electric power industry, analyze possibile amounts of regional demand and transmission to outside areas, adapt to local conditions to select optimum points and deploy power sources, and achieve mutual coordination and mutual regulation between hydropower and thermal power. Second, we should integrate with comprehensive development planning for river basins and foster the benefits of comprehensive utilization of hydropower resources, especially comprehensive utilization for flood prevention, irrigation, water supplies, water-borne transport, and so on. Third, we should integrate with development of the three provinces' abundant mineral resources and agro-forestry resources, and promote development of the raw materials, chemical, iron and steel, and agricultural and sideline products industries. In the Panxi-Liupan Shui Development Zone and the economic development zone which relies on the Chengdu and Chongqing regions, for example, there should be a raw materials, chemical, and metal smelting industry base area centered on Lancang Jiang Hydropower Station and Kunming City, a raw materials and chemical industry base area mainly involving aluminum and phosphorous and an agriculture and subtropical crops production and processing industry base area, and so on in the Wu Jiang Hydropower Station, Guiyang, and Zunyi region. Fourth, they should fully play their role in compensating for crossing over river basins, attain the maximum proportions and levels in transmitting power to other regions and power output, and achieve a rational structure of power sources and grids in the electric power structure.

B. The focus and deployments of base area construction

The focus and deployments of base area construction are: 1) Jinsha Jiang Hydropower Base Area; 2) Lancang Jiang Hydropower Base Area; 3) Min Jiang and Dadu He Hydropower Base Area; 4) Yalong Jiang Hydropower Base Area; 5) Wu Jiang Hydropower Base Area; 6) Hongshui He Upper Reaches Hydropower Base Area; 7) Liupan Shui Coal and Power Base Area; 8) Zhaotong Coal and Power Base Area, and so on.

C. Development goals

The development goals are based on three stages. The initial proposal calls for developing to 110 billion kWh in the near term (the year 2000), 300 billion kWh in the medium term (2020), and 700 billion kWh in the long term (2050).

D. Difficulties in engineering technology and topics to attack key problems

The difficulties in engineering technology and topics to attack key problems are: 1) Research on river basin cascade development system plans and hydropower economics analysis and theory; 2) The engineering geology characteristics of complex batholiths for high dams; 3) Research on large underground chambers, deeply buried long tunnels, and stability of surrounding rock and high slopes; 4) Research on dam construction technologies for high concrete dams and high earthen dams; 5) Development of new types of high-capacity high specific rotation velocity water turbine generators; 6) 750 to 1,000 kV-grade EHV power transmission technologies and development of complete sets of equipment and EHV DC power transmission technologies; 7) Research on comprehensive automation of hydropower stations, optimized dispatching and economical operation of hydropower station groups and cascade hydropower stations, and so on.

E. Policies and measures for accelerating base area construction

The policies and measures for accelerating base area construction should include: 1) First, to solve the problem of insufficient funds for preparatory work, I propose that the state establish a special preparatory work fund allocated for hydropower or increase the price of electricity by 0.002 yuan per kWh as preparatory work funds; 2) Establish shared responsibility for raising construction funds and comprehensive utilization of investments, policies for exemption from income taxes during the period of loan repayment, tax regulation, and so on; 3) Formulate policies for placing resettled people; 4) Implement policies for exemptions from land occupation taxes for requisitioned cultivated land; 5) Implement a new hydropower development system and management system (such as the Wu Jiang Hydropower Development Company, etc.) with independent administration and responsibility for their own profits and losses, and give them the capacity for using power to develop power and self-development.

Big 1200-MW Zou Xian Plant Is Nation's Sixth-Largest

906B0078D Jinan DAZHONG RIBAO in Chinese 1 Dec 89 p 1

[Article by Bao Jimin [7637 4949 3046] and Wang Wensheng [3769 2429 3932]: "Zou Xian Power Plant Completed: Province's Largest"]

[Text] On 30 November [1989], as its No 4 power generating unit smoothly passed full-load tests and was officially handed over for commissioning, the stage 2 project of the Zou Xian power plant was entirely completed. As a result, the power plant's total installed capacity reached 1.2 million kilowatts, making it the sixth-largest in the country and the largest in the province [Shandong]. The Zou Xian power plant, located on the west slope of Mount Feng Shan in the native place of the philosopher Mencius, is a national key construction project of the Seventh 5-Year Plan, in which a total of 1.23 billion yuan has been invested. It was built in two stages, each involving the installation of two 300-kW generating units. The entire project was designed by the Northwest Electric Power Design Institute, the main engineering construction was performed by the Shandong No 1 Electric Power Construction Company, and the main equipment was produced by domestic plants. The official groundbreaking occurred on 1 October 1983, and stage 1 was completed in November 1986.

The Shandong No 1 Electric Power Construction Company encountered serious problems during construction, including a tight construction schedule, delays in equipment deliveries, and the transfer of large numbers of key technical personnel to support the construction of a nuclear power plant project. In order to deal with these reverses, the company relied closely on the working class, held a labor competition, and stimulated a spirit of dedication. A way of dealing with the situation was found by increasingly thorough reform, implementing the economic responsibility system at all levels, increasing efficiency, and decreasing production costs, so that the construction cost per thousand watts fell to 1,022 yuan, one-fourth below the national average for comparable units. The entire second-state project took only 73 months, 12 months shorter than the national norm. Of more than 2000 items that passed acceptance tests, 96 percent were rated Superior. The first stage won a state superior engineering quality award, and the construction quality in the second state was superior to that in the first. The first three generating units are expected to operate for more than 7000 hours under full load during the first year, higher than any other comparable plant nationwide.

Construction on Ningxia's Daba Plant Accelerated

906B0078A Beijing RENMIN RIBAO in Chinese 14 May 90 p 1

[Article by Huang Yiming [7806 5042 2994]: "Construction on Daba Power Plant in Ningxia Accelerated"]

[Text] Yinchuan, 13 May—The construction of a major project of strategic significance, the Daba electric power plant in Ningxia, is proceeding night and day an intense pace and the first 300-kW generating unit will be in operation before this year's National Day festival.

The Daba Power Plant is the fossil-fired power plant with the largest unit capacity in Northwest China. When all three stages of its construction are completed, the total installed capacity will be 2.4 million kW. The stage-1 project currently under construction will consist of two 300-kW units. The first 300-kW unit is expected to come on stream at the end of September, and construction of the second generating unit is preceding at a vigorous pace: it is scheduled to be in operation in the fourth quarter of next year. At that time, Ningxia's generating capacity will have increased by 80 percent, which will greatly alleviate the tight energy supply in Ningxia and Northwest China. The first unit alone will produce a rather large increase in Ningxia's financial revenues.

Ningxia's proved coal reserves are fifth in the country, and the reserves of the Lingwu coalfield that is now under development account for 73 percent of the province's total reserves. When the Daba Plant is completed, its annual coal consumption will be 7.2 million tons, which will greatly promote the development of Ningxia's coal industry.

Construction work on the Daba plant began in April, 1988. The civil engineering work is being performed by the Ningxia No 2 Construction Engineering Company, and installation by the Northeast Electrical Industry Management Office's No 3 Engineering Company. Some 5,000 construction workers are racing against time and competing against each other in an all-out effort to use new equipment and disseminate new technologies. The project team headed by Muslim worker of the region's No 2 construction company Ding Shanbao [0002 0810 1405] was the first to use the "electric-powered [concrete-pouring] form raising process", with which it built a 210-meter tall smokestack whose quality was at the national Superior level. In November 1988, the East China No 2 company's personnel completed the installation of a 150-ton "tank hoist" in 7 days; two Japanese engineers at the site were amazed.

At present, in the sands of the Gobi, the construction collective working on the power station has taken preliminary shape, and line on line of employee residences and amenities are spreading over the land: a new small city is taking shape here.

Chengdu Power Plant 200-MW Expansion Project Becomes Operational

906B0078B Chengdu SICHUAN RIBAO in Chinese 29 Apr 90 p 1

[Article by Huang Yuanliu [7806 6678 3177]: "Chengdu Fossil-Fired Plant's New Generating Unit to Become Operational"]

[Text] The Chengdu fossil-fired power plant's 200-kW expanded unit was smoothly integrated into the grid for power generation on 31 March; it has now entered the production preparations stage.

Sichuan has a shortage of electricity, particularly in Chengdu; the actual amount of electricity that can be supplied is only half of what is required. In April 1987, during an inspection trip to Sichuan, Premier Li Peng directed that: "We must accelerate electric power construction in Sichuan." On 26 February 1988, the Chengdu fossil-fired power plant expansion project, approved by the State Council, was begun as an "emergency project." In the course of 2 years and 1 month of arduous effort, this project was completed with the accolade of "high speed, high quality, and conservation of investment funds," and was handed over to the people of Chengdu. The preparatory work between approval of the project and the beginning of work on the main project was completed in only 5 months. By means of separate test operation and preliminary joint startup tests, the three main units and the main auxiliary equipment were installed with good quality and achieved preliminary success.

The expansion of this plant involved joint electric power generation investments by the Huaneng International Electric Power Development Company, the Chengdu City Seamless Steel Pipe Works and the Dongfang Power Plant, with the participation of the province's electric power office in order to assure that the investors would receive electric power on a priority basis and would gain the appropriate benefits and to motivate the local electric power suppliers. In the course of a year, the Dongfang Electric Power Equipment Set Procurement Company, the main contractor, managed to have more than 1,000 pieces of equipment on site and awaiting installation in accordance with the project schedule. The province electric power office gave the project its enthusiastic support. The Chengdu Seamless Steel Pipe Works guaranteed the supply of 2,500 tons of steel pipe needed by the project. The Chengdu branch of Huaneng, which was in charge of the project, achieved a 97.8 percent investment realization rate, the highest figure for all key projects in the province.

The Chengdu Municipal Electric Power Engineering Headquarters and the more than 400 construction workers of province electric power construction companies Nos 2 and 3 who took part in the expansion project overcame difficulties resulting from the smallness of the site and the tightness of the construction schedule. In the spirit of stubborn struggle to "bring light to the people of Chengdu," they gave up their weekends and holidays and steadily o73 maintained a superior rate of progress on the project.

600-MW Unit To Come on Stream in Huainan

906B0078C Shanghai WEN HUI BAO in Chinese 29 Apr 90 p 1

[Article by Zhang Dahe [1728 1129 0735]: "600-MW Generating Unit to Be Commissioned on 4 May"]

[Text] A 600-MW steam-powered generator unit, Chinese-built with imported technology, with the largest unit capacity in China, will be commissioned on May 5 at the Pingwei Power Plant in Huainan.

China's independent construction of a 600-MW generating unit, included among the 12 major technology and equipment projects under the direct leadership of the State Council was completed on 15 December, 1988, and adjustment activities demonstrated that the degree of automation of the unit was high, that it was safe and reliable, produced high economic benefits, was technologically advanced, and was on a par with the 1980's world state of the art. The Ministry of Energy and the Ministry of Electromechanical Machinery decided to commission it officially. In addition, this unit will be the basis for lot production of a finalized design for main power units in the 1990's.

State Planning Commission Approves Jiaxing Power Plant

OW1210111690 Hangzhou Zhejiang Provincial Service in Mandarin 1000 GMT 10 Oct 90

[Report by reporter Weng Peirong and correspondent Zhang Hongyan]

[Text] The State Planning Commission has recently approved a thermal power plant in Jiaxing, Zhejiang. The construction will be started next year. The first generating unit is expected to be installed and put into operation in 1993.

The Jiaxing Power Plant is a key construction project of Zhejiang during the Eighth Five-Year Plan. After completion, the power plant will ease the power shortage in Zhejiang and other regions in Central China.

The Jiaxing power plant, which has been approved for a total of 1.15 billion yuan investment, will have a total planned capacity of 2.4 million kW. In the first stage construction, two domestically made 300,000 kW coal fired units will be installed. It is estimated that the two units will be completed and put into operation in 1994 and generate 3.6 billion kWh of electricity annually. According to a briefing, the site of the power plant has been decided in Pinghu County between Zhapu Port and the Qinshan nuclear power plant where the coastline is stable, water transportation is convenient, and a spacious lot is available for construction of the power plant. Zhapu is also the center of the Central China power grid.

Experts Caution Against Unrealistic Optimism Over Coal Resources

916b0007A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 12 Sep 90 p 2

[Chinese Scientific Joint Draft [0022 4430 0588 0180 4473]]

[text] There is a popular perception that coal is one of China's superior points of strength, and that reserves are sufficient to supply the country's needs for 2,000 years; only problems of capital and transportation need be overcome to absolutely guarantee the supply. Experts attending the Scientific Conference on Rational Development and Exploitation of National Coal Resources believe this view is premature, and the circumstances of national coal reserves need concrete analysis. There can be no blind optimism. Conservation measures must be adopted to effect rational development and utilization.

The basic estimates on national coal resources from experts are as follows:

1. The total volume of reserves, though large, is about average relative to population. There are three sets of figures currently being used to represent national coal reserves: (1) 5 trillion metric tons represents the total resources above a depth of 2,000 meters; (2) 3.8 trillion metric tons (some sources use 4 trillion) represents the total resources above a depth of 1,500 meters, before forecasted estimates are taken into account; (3) 2 trillion metric tons, represents total resources above a depth of 1,500 meters, after reliable portions of forecasted estimates are considered. These three sets of figures all have a scientific basis, and in theory, basically reflect the reserves of coal in deposits under the natural conditions that exist within China's borders. But it must be pointed out that the above stated totals are geological conceptions and cannot be directly used for programming construction, and although the total figures are great, they only approximate those of an average country in proportion to population.

2. Proven deposits that can be developed into new mines are insufficient. Of the known deposits shown on the national resources chart of 1 Jan 1990, over 900 billion tons of deposits were, for the most part, not thoroughly explored, and additional major geological exploratory work is required before they qualify for development. Of the above mentioned 900 billion metric tons, less than 250 billion can be made ready for exploitation, of which 170 billion tons of deposits are in the process of mine construction, 20 billion can't be utilized for the time being, and 50 billion tons of deposits only partly meet requirements for mine development.

3. The distribution of these areas is very uneven. Coal reserves in the economically developed east coast and southern areas are poor, while in the northwest frontier of Xinjiang they are very rich. There are valuable coal rich areas in Shanxi, Shaanxi, and western Nei Monggol. Shipping northern coal south and western coal east will be the lasting pattern.

4. Coking coal prospects are fairly bleak. Only 1/5 of the total coal reserves are suitable for making coke, and proven deposits of coking coal already make up 30 percent of total known coal deposits, and annual production volume is up to 50 percent of the total national coal production. And moreover, quality coking coal, low in ash and sulphur, is already getting top priority exploitation, the remainder being of inferior quality. Studies show that by the year 2030 or 2050 national coal reserves distribution and coal quality problems will be even more evident, and solutions even more difficult. For sustained and steady economic development effective measures must be taken, starting now, to maintain coal reserves.

In view of this situation experts make the following suggestions:

1. Stop wasteful practices in exploitation of coal reserves. The Mining Production Controls Law already passed should be fully enforced. The leadership concerned should clear up and correct policy and practices that are not beneficial to conserving resources. They should study, formulate, and perfect regulations for conserving resources, and resolutely put them into practice.

2. Adopt strict measures to conserve coking coal reserves. A large part of the 50 percent of total coal reserves that is being used for coking coal is used for generating power. Faster development of low rank bituminous coal, and exploitation of anthracite is advised to save precious coking coal reserves. No new coking coal bases should be constructed for some time to come, those that are already programmed should be postponed, and controls limiting exploitation should be placed on those already in production or under construction.

3. Consolidate development and utilization of intergrowth minerals in coal bearing strata. Minerals such as kaolin, pyrite, etc., must hereafter be considered in consolidated exploration, appraisal, development, and utilization, so that coal and its intergrowth resources can be fully developed and effectively used in order to upgrade coal mining economics.

4. Strengthen basic coal research, to include new petrographic classification research with an emphasis on coal ranking indicators, and research on mechanics of intergrowth formation. In the process of oil field exploration and well construction, environmental geology must be advanced; investigate and study unsafe geological conditions, formulate and adopt environmental geology conservation and disaster prevention measures.

Jungar: Nation's Largest Coal Mine Project

906B0091C Beijing RENMIN RIBAO in Chinese 25 May 90 p 1

[Article by reporter Ao Teng [0277 7506]: "Curtain Opens on Battle at Jungar Coal Field, Largest Construction Project in China's Coal Industry, Proven Reserves of 27.2 Billion Tons, Investment of 4.14 Billion Yuan"]

[Text] The curtain has opened on the battle at the largest construction project on China's coal battlefront, Jungar Coal Field. A huge construction army of more than 10,000 has now assembled at the coal field construction site and the formerly vast and open loess plateau is now full of activity. Tents and construction sheds are now scattered among the mountainsides and gorges and the smoke from chimneys floating like billowing clouds and the roar of engines have brought flourishing vitality to the area.

Jungar Coal Field is located on the loess plateau in the eastern part of Jungar Banner in Inner Mongolia Autonomous Region's Ih Ju League 100 miles from Hohhot City. The coal field is 65 kilometers long from south to north and 21 kilometers wide from east to west. It covers a total area of 1,365 square kilometers and now has proven reserves of 27.2 billion tons.

Jungar Coal Field is a comprehensive project involving simultaneous construction of coal, power, and transportation. Also to be built in synchronization with the coal field is a 6 kilometer-long single-line electrified railroad from the coal field to Fengzhen Station on the Jingbao [Beijing-Baotou] Railroad, highways from the mining region to Hohhot, Dongsheng, Baotou, and Pingshuo Coal Mine in Shanxi, and a pit-mouth power plant with an installed generating capacity of 200 MW. The total investment will be 4.14 billion yuan.

Preparations for construction of the first stage project at Jungar Coal Field began in 1976. Projects already completed include the Ho-Jun [Hohhot-Jungar] highway and the No 1 highway in the mining region. The water supply project with a 10,000-ton daily supply capacity is now under construction and a small residential area in the mining region has attained a preliminary scale. The routes of the No 2 highway, southern highway, and Pida highway in the mining region have been shifted and construction of the 220 kV Ho-Jun [Hohhot-Jungar] high voltage power transmission line is now begin speeded up. The overall design for the mining region has been inspected and preliminary inspections of the designs for each project have been completed. Construction of the modernized open-cut mine, pit-mouth power plant, dedicated electrified railroad, and other key projects at Heidaigou will begin. The entire project will be completed by the end of 1992 and will ship out large amounts of coal in 1993.

Implementation of unified planning, unified construction, unified management, and unified administration for construction of Jungar Coal Field is a new trial for reform of China's capital construction system. Li Changqian [2621 7022 6197], deputy commander over construction of the coal field, told reporters that Jungar Coal Field is a group project that crosses over industrial and specialization boundaries and uses the most advanced Chinese and foreign technology and equipment. The construction staff was assembled through bidding and the personnel through selection. As a result, we are full of confidence.

Development and construction of Jungar Coal Field will play an enormous role in promoting economic and cultural development on the loess plateau. The coal field has selected several local young peasants and pastoralists from all banners for specialized training who will serve as technical workers in the future. Many young people who left school or did not continue with their educations after graduating from elementary school in the past are entering continuing education classes to prepare for participation in future employee recruitment tests at the coal field. The huge gate of Ordos Plateau which was closed in the past will be forced open by modern civilization as Jungar Coal Field is built.

Enormous Malan Mine Completed

906B0091B Taiyuan SHANXI RIBAO in Chinese 28 Jun 90 p 1

[Article by reporters Ji Zhenrong [1213 2182 2837] and Luo Jinqing [3157 2516 3237]: "Huge Malan Mine Completed and Placed Into Operation, A Huge Army of Nearly 10,000 Builders Has Fought for 6 Years, Design Annual Production Capacity 4 Million Tons of Raw Coal"]

[Text] After 6 years and 7 months of hard battle by nearly 10,000 builders, huge Malan Mine in Gujiao Mining Region, which has a yearly production capacity of 4 million tons of raw coal, was formally completed and placed into operation on 27 Jun 90.

Malan Mine was designed by the Taiyuan Raw Coal Mine Design and Research Academy. Construction began on 20 Nov 83. Xishan Mining Bureau's Gujiao Mine Construction and Engineering Department, Third Department of the 25th Company in the Ministry of Nuclear Industry, Sichuan Coal Capital Construction Company Ninth Department, and Coal Construction and Installation Company 13th Department were responsible for construction of the mineshaft and roadway projects, while Xishan Mining Bureau Gujiao Engineering Department and other units were responsible for the surface projects. The construction schedule was 6 years and 7 months. During the construction process which lasted over 6 years, Gujiao Mining Region Construction Headquarters made rational arrangements of construction forces, scientifically deployed construction sequences, carefully organized a construction battle, dealt with the depth of coal seam burial, design shafts, and other characteristics and moved forward with 9 shafts at the same time. The construction program for dismembering and connecting the main large shafts

widely adopted ramming processing of the ground and new round shaft and square shaft tower sliding model techniques which accelerated the pace of construction. The people of Gujiao City fostered the glorious revolutionary tradition of people in old revolutionary base areas to support mine region construction and make major efforts to accelerate mine construction. Now, all mine production systems and surface raw coal storage, loading, and haulage systems have taken shape and trial haulage and auxiliary facilities have been completed.

After the ribbon cutting ceremony was completed, the first train load packed with "black gold" gave a long blast of its horn and pulled out of Malan Mine.

Brief Introduction to Malan Mine

Malan Mine is the third mine to be built and placed into operation in Gujiao Mining Region following Xiqu and Zhenchengdi mines.

The shaft field at Malan Mine covers an area of 74.74 square kilometers. It has 1,021,196,000 tons of industrial reserves and 602.72 million tons of recoverable reserves. There are a total of nine extractable coal seams and the main coal types are rich coal and coking coal.

The design capacity of Malan Mine is yearly coal output of 4 million tons. It was opened using inclined shafts. There are 10 stope faces (six using fully mechanized mining and four using high-level extraction) deployed in four mining areas. The total length of the mining faces is 1,440 meters. The budgeted investment is 496 million yuan. The total amount of shaft engineering is 60,417.7 meters and the total area of structures is 311,588 square meters.

Malan Mine has installed a steel cable reinforced belt conveyor that has the largest single unit capacity and longest haulage distance in a Chinese coal mine at the present time, the largest power multi-cable friction hoist, and the first 5-ton side dumping mine carts that were developed by China herself.

Construction and startup of Malan Mine indicates that construction in Gujiao Mining Region has entered a new stage. The mining region has now formed a yearly raw coal production capacity of 8.5 million tons.

Photo caption: Another huge coal mine with a yearly production capacity of 4 million tons in Shanxi Province, Xishan Mining Bureau's Malan Mine, is formally placed into operation. The photo shows leading comrades from the Coal Corporation and Shanxi Province cutting the ribbon to place it into operation.

Newly Discovered Deposits in Shanxi Could Exceed 5 Billion Tons

906B0091A Taiyuan SHANXI RIBAO in Chinese 23 Apr 90 p 1

[Article by Hu Wenliang [5170 2429 0081]: "Shanxi Province Proves a Huge Coking Coal Field with Total Coal Reserves of 7.2 Billion Tons, Including Newly Proven Reserves of 5 Billion Tons"]

[Text] After 5 years of field exploration and geological research work, the 148th Geology Team in the Shanxi Coal Field Geology Bureau proved the first huge coking coal base area in Shanxi Province.

This huge coking coal base area is located in the middle of Shanxi's Hedong Coal Field in Linxian, Liulin, and Lishi counties and covers a total area of 500 square kilometers. In June 1985, in order to meet national economic requirements in long-term plans for coking coal use in China and rational development of coal resources in Liliu Mining Region, the 148th Geology Team in the Shanxi Coal Field Geology Bureau assumed responsibility for prospecting tasks in Liliu Mining Region. They invested over 6 million yuan and after nearly 5 years of field prospecting and geological research as well as compiling geology reports, they submitted the SHANXI HEDONG MEITIAN LILIU KUANGQU SANJIAO KANTANQU YANGCHA DIZHI BAOGAO [Sample Survey Geology Report for the Three Borders Prospecting Region in Shanxi Hedong Coal Field's Liliu Mining Region], which passed provincial-level appraisal. They derived total coal reserves of 7.2 billion tons, including newly-proven reserves of 5 million tons. These geological achievements made an enormous contribution to the cause of China's energy resource industry and the metallurgical and chemical industries.

Curtain Goes Up on Eastern South China Sea Production

916b0001C Guangzhou NANFANG RIBAO in Chinese 4 Sep 90 p 1

[Article by Fan Renren [4636 0117 0088]]

[text] China's first 1-million metric ton per year commercial ocean oil field, Huizhou 21-1, has just been completed, and will go into production this month. It is the curtain call for large scale exploitation of eastern South China Sea oil fields.

Huizhou 21-1 is located about 200 kilometers southeast of the mouth of the Pearl River in waters 116 meters deep. It is being developed as a cooperative effort between Eastern South China Sea Petroleum Company of the China National Offshore Oil Corporation and ACT Consortium (composed of three members: Italian Agip (International) Ltd., U.S. Chevron International Oil Ltd., and U.S. Texaco. There are 20,680,000 cubic meters of crude oil (equivalent to 16,660,000 metric tons), and 2.08 billion cubic meters of natural gas in the geologic reserves of this oil field. The total developmental investment was 240 million U.S. dollars (of which China's investment was 51 percent, the others, 49 percent). There are, in all, 50 wells, two wells per pool using hydraulic systems. Advanced submersion engineering extraction methods are being used, and after the oil has undergone processing, it will be shipped out by tanker for sale.

Large-scale exploration of eastern South China Sea oil and gas resources with foreign cooperation began in 1983. In the past 7 years, the U.S., U.K., France, Italy, Holland, and Japan, among thirteen countries, and 27 oil companies have signed 26 cooperative exploration contracts and agreements with the Eastern South China Sea Petroleum Company of the China National Offshore Oil Corporation. They have closely cooperated with the Chinese in drilling 60 exploratory wells and 40 appraisal wells on over 80,000 square kilometers of contracted territory. Of the 60 exploratory wells, 20 struck oil bearing structures for a success rate of 33 percent, rather high among international explorations. For each well drilled there is a possibility of finding 6,250,000 metric tons of reserves with a possible yield of 1,652 tons per meter depth. For every 10,000 U.S. dollars invested 600 tons of oil can be recovered. These figures show that the exploration and development of petroleum in the eastern South China Sea is economical.

As it appears, other oil fields in the eastern South China Sea will be coming on stream in the coming years. Annual crude oil production next year could be over 2 million metric tons. By 1995 it could be over 5 million metric tons. In the 1990's the Eastern South China Sea Oil Company will become an important offshore oil production base for China.

Zhongyuan Fields Now National Leader

916b0001a Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 12 Aug 90 p 1

[Excerpts] Zhongyuan Petroleum Prospecting Bureau, supported by scientific advances, has accelerated oil field exploration. It leads the nation in crude oil production volume.

The oil field now exploited by Zhongyuan is in an area where gas and oil is deep, and geology complex, and where prospectors and developers met one problem after another. Facing this situation when it went into this operation in 1979, the Bureau clearly stated a policy of seeking reserves, yield, and benefits through scientific and technological advances, and thus prescribed several measures: The first was to open up technological cooperation and exchange, and launch an S & T attack. From 1983 to 1986, there were 51 scientific research units, universities and colleges, and nearly 200 experts, professors, and S & T personnel who came to the Zhongyuan oil fields to participate in this effort. Second was to absorb advanced foreign technology and facilities. Over the past several years the Bureau has received 4,859 advanced technology equipment sets and facilities from the U.S., France, and West Germany, including systems for seismic prospecting, well logging, slurry, and computer processing. Third was to cultivate S & T talent, and raise the quality of staffs and workers. From among technicians with sufficient practical experience and college students, 1,218 individuals were selected for further training at colleges and universities and for training abroad. The fourth measure was to further the reform of the S & T system with special attention to be given to turning S & T results into production. [passage omitted]

Oil output has multiplied by 32 times its original amount within the past 10 years, and per-capita output value has grown from 4807 yuan in 1980 to 25,277 yuan [in 1990].

One of World's Biggest Oil Deposits May Lie Off Shandong

906B0076C Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 9 Mar 90 p 1

[Article by Li Xiguang [2621 1585 0342]: "Rich Huanghe Delta Accumulations of Oil, Gas and Salt Believed by Scientists To Be World's Largest"]

[Text] Xinhua, Beijing, 8 March—The most recent research and geological surveys indicate that the Huanghe Delta, located on the Shandong peninsula, may contain one of the world's richest accumulations of oil, gas and sea salt, with immense development potential.

Academic Committee Chairman Ren Mei'e [0117 5019 6948] of the Chinese Academy of Sciences [CAS] made this revelation here at the CAS Academic Committee plenary session.

Professor Ren Mei'e stated that the Huanghe delta is unique in the world. The Shengli oilfield centered on this

delta has abundant resources, and in the near future its annual output is likely to rise to 50 million tons. In the last 10 years, rich oil and gas resources have been found in coastal sand flats and shallows, and a succession of new large oilfields have been discovered.

According to the renowned Chinese geologist, recent exploration results also indicate not only that the proved oil and gas reserves of the Huanghe delta are immense, but also that their geological conditions are excellent and that they may be one of the richest oil and gas regions of China or even the world, constituting a "golden triangle" of Chinese petroleum.

Ren Mei'e stated that since development of the petroleum reserves in this region began in the 1960's, the Huanghe delta has become China's second-largest petroleum production base. The Shengli oilfield's center of oil production is gradually shifting to the coastal belt. From north to south along the shore of the Huanghe delta there are already five major oil fields, the largest of which, the Gudong oil field, has an annual output capability as high as 5 million tons.

According to Ren Mei'e, the Laizhouwan coastal shallows area in the southern part of the delta is very extensive; it has favorable climatic conditions, and sea salt production there has great development potential. In addition, the area has abundant underground brine, and in the last few years it has developed into a new sea-salt production base. By 1995 the annual output of sea salt is scheduled to reach 4 million tons, and the production scale will ultimately be 10 million tons a year, making it China's largest salt field.

The Huanghe delta has thus far been developed only to a small degree, with large areas of wasteland and a relatively sparse population. But experts o73 believe that as the petroleum industry develops, agriculture, stock raising and mariculture are sure to expand rapidly.

In order to facilitate petroleum export, China has already begun to build a large port, the Huanghe Seaport, north of the mouth of the Huanghe.

Output From Liaohe Continues To Increase

916b0001A RENMIN RIBAO OVERSEAS EDITION in Chinese 28 Aug 90 p 3

[Article by XINHUA Shenyang cable, reporters Xiang Chen [7309 5256] and Dai Eryi [6528 3643 5030]]

[Excerpt] Shenyang (XINHUA)—Aided by scientific advances, the Liaohe oil field has solved the problems of prospecting in the multiple-fault block geology of Liaohe Basin gas and oil fields and resolved techniques for developing its heavy and high viscosity oils. In the past 20 years over 2,300 technological successes have been achieved, and 71 major science and technology awards have been won at the national, ministerial, and provincial levels. These achievements have pushed crude oil production up to an average annual increase of 1 million metric tons, doubling production volume in 6 years, and making Liaohe the nation's third largest oil field.

World-class extraction technology for heavy oil is still limited to depths of 500 to 1,000 meters, but Liaohe has already mastered six major thermal extraction techniques for recovering heavy oil from depths of more than 1,500 meters. By combining imported technology with local "oilman know-how", and through digestion, absorption, and creativity, they have assembled a complete cyclic steam injection oil extraction technology with gas completion wells, heat injection, well insulators, high temperature high pressure well gages, well head assemblies, surface collectors, including equipment and tools that have taken first place among national products, some of which encompass technologies that are up to world standards.

The Shenyang oil field, a subordinate of Liaohe, is the largest high-viscosity oil production base that has been built with foreign capital. Here, the high viscosity oil has a paraffin content of 50 percent with a maximum melting point of 67° Celsius. It has the highest paraffin melting point of any high viscosity oil production facility in the world, and it makes extraction extremely difficult. Liaohe oil field technicians and workers tackled this problem vigorously, and in only 1 year's time the oil field went into high viscosity oil production, completing the national Seventh 5-Year Plan target 4 years ahead of schedule. [passage omitted]

Three New Wells Discovered in Turpan

916b0001a Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 28 Aug 90 p 3

[Article by Hao Liping [6787 0448 1627] and Zuo Yuli [1653 3768 7787]]

[Text] Yumen Petroleum Administrative Bureau prospecting units drilling in the Turpan Basin of Xinjiang have scored breakthroughs in providing initial evidence that Turpan is another rich oil and gas basin in western China. It is now known that three gas and oil fields, Shanshan, Yilahu, and Qiuling, possess up to several tens of million metric tons of oil and gas reserves with a foreseeable production capability of one million tons per year.

Three years ago, after Yumen prospecting units entered Turpan Basin, seismic investigations of 14,000 square kilometers were completed, and 58 exploitable locations were found. The test well success rate reached 50 percent, well above world average. It has been ascertained that the oil strata are deep, not far down, production yield is high, quality is good, and gas and oil reserves are plentiful. The Shanshan oil field is about on a level with the present Laojunmiao oil field in scope, but oil and gas reserves at Qiuling oil field are even greater. It adjoins Shanshan, and promises to be a segment of rich reserves and high productivity with all the requisite conditions for building a large scale oil and gas field.

There are already 32 test wells and operating wells in the Turpan Basin prospecting area, and facilities to support the oil field test development area, a satellite receiver ground station, and water and oil storages are all underway. Construction of a dedicated rail line to Yumen Oil Field headquarters has also begun.

Liaohe Field Achieves Large Increase in Crude Oil Output

906B0076B Shenyang LIAONING RIBAO in Chinese 22 Mar 90 p 1

[Article by Dai Eryi [2071 1422 5030] and Sun Yuqi [1327 0827 1142]: "A Great Advance in Science and Technology, A Large Increase in Crude Oil Output"]

[Text] Relying on scientific and technological progress, the Liaohe oilfield has successively overcome a number of difficult problems in the theory of gas field exploration in a complex river-basin fault block and in the technologies for the development of dense oil and high-viscosity oil. In the 20 years since development began there on 22 March 1970, it has obtained more than 2300 scientific and technical results and more than 10,000 mass-style science and technology innovations. It has won 9 state scientific and technological progress awards and 62 major ministry- and province-level science and technology awards. These results have promoted crude oil production. Starting in 1983, the oilfield succeeded in increasing annual crude oil output by a million tons for 7 years running, and in the last 6 years its crude oil output has doubled. In 1985 it became "Number 3 in Oil." Its 20-year cumulative output is 105 million tons of crude oil and 24.1 billion cubic meters of natural gas.

The Liaohe oilfield has the most complex geology in eastern China. It is a typical fault-block oil and gas field with an extremely great variety of reservoir strata. In the course of 20 years, the scientific and technological personnel have joined with the production workers to break free of a succession of traditional geological research methods and theories. They have evolved a unified series of research and process technologies for exploring and developing large, complex oil and gas reservoirs and pools containing special-property oils. They have found 21 oil and gas fields in the Liaohe basin and 14 oil-containing structures that have already yielded commercial flows of oil and gas and have systematically described or discovered 25 types of oil and gas pools. They have succeeded in proving geological reserves totaling more than 100 million tons every year since 1984. In the Damindun Depression structure they used a new scientific technique to reevaluate petroleum resources, with the result that the proved geological reserves have increased rapidly from 53 million tons in 1975 to 400 million tons today.

World dense-oil extraction technology is currently limited to depths of 500 to 1000 meters, but the Liaohe oil field had to take on six major technologies for thermal extraction of dense oil at depths of up to 1500 meters. They assimilated new imported technologies and revamped them to fit their local oil conditions; in 3 short years they created a production technology that comprised a full set of pass-through steam extraction technologies, including steam-injection well completion, hot injection operations, well-bore insulation, high-temperature and high-pressure testing, wellhead equipment, o73 and surface oil collection, with the ability to operate normally at high pressures and temperatures to depths as great as 1600 m. They are national leaders in terms of the degree of domestic production of their equipment, and some of their processes are already on a par with the world state of the art. The breakthroughs in dense oil development technology enabled the Liaohe oilfield to increase its output of dense oil from 13,200 tons in 1982 and 1.35 million tons in 1985 to 4.59 million tons in 1989, accounting for two-thirds of total world output of dense oil, with the result that China has become one of the world's four top producers of dense oil.

The Liaohe oilfield is China's largest high-viscosity oil production base built with foreign capita. Its high-viscosity oil contains up to 50 percent wax, and its highest solidification point is 67 degrees Celsius, the highest solidification point of any high-viscosity oil currently being developed anywhere in the world. The scientific and technical personnel and workers of the Liaohe oilfield displayed a proprietary spirit, with mass-style policy making and mass-style effort, and it took them only 1 year to build the oilfield facilities put them into production, completing their Seventh 5-Year Plan quotas 4 years ahead of schedule. As a result, this oilfield, which long had failed to produce a drop of oil, reached a crude oil output of 2.82 million tons in 1989. The 10 major new technologies that they independently designed and built, such as hydraulic piston pumps, circulating hot-liquid spontaneous ejection, waste-heat high-temperature collection and transport, strong-magnetic-field wax protection, and electric heating to remove plugs, have already passed the test of three severe winters, and the Shen-Fu [Shenyang-Fushun] underground pipeline has remained open without blockage.

Dissemination of the new technology of cluster well drilling is one of the distinctive characteristics of the Liaohe oilfield, and it has already completed 2,136 directional slant wells and 644 cluster wells and has fully developed 10 fault-block oil and gas fields; it is a national leader in both the number of wells drilled and in well drilling standards. It has saved a total of 66.07 million yuan in construction investments and conserved 3,504 mu of land.

Sichuan Adds 15 New Gas Wells

906B0076A Sichuan CHENGDU RIBAO in Chinese 15 Mar 90 p 1

[Article by Hu Xiaoping [5170 1420 1627]: "Fifteen New Gas Wells Obtained"]

[Text] In the first spring of the 1990's good news came from the Sichuan Gas Field, which accounts for 42.8 percent of total national natural gas output: in the first 2 months of this year, 15 new commercial natural gas wells were added, with yields of up to 1.03 billion cubic meters, an increase of 4.8 percent over the same period last year, marking this production office's best start in recent years.

At the beginning of this year, the office accelerated the pace of petroleum and natural gas exploration, striving for speed and benefits, and strove hard to increase natural gas reserves and output. On the one hand, it invested a large percentage of its scarce resources on production, and on the other hand, it held an extensive a labor competition focused on assuring that targets would be met and striving to overfulfill them, mobilizing all workers and staff. Personnel of the East Sichuan Drilling and Exploration Company overcame the difficulties posed by heavy snows and cold weather to find a high-output gas-rich field and obtained two natural gas wells that gave test yields of over 1 million cubic meters per day, and their monthly drilling footage exceeded the quota by 26 percent. The South Sichuan, Southwest Sichuan and Central Sichuan mining districts persisted in strengthening management and technical measures and signed a contract for every well, saw to it that engineering work was in accordance with design, and increased their exploratory well drilling footage, with the result that they were able to come up with a group of high-production gas wells.

Shengli Drafts Plans for Onshore, Offshore Exploration

40100009b Beijing CHINA DAILY (BUSINESS WEEKLY) in English 29 Oct 90 p 1

[Article by staff reporter Xie Songxin: "Search for Oil Reserves"]

[Text] Dongying, Shandong Province—Shengli Petroleum Administrative Bureau is working on a five-year plan to extensively search for new reserves around the Yellow River Delta to ensure its position as China's second largest oil producer.

Oil analysts expect that the central government will encourage Shengli's massive exploration plan as the production in Daqing, China's largest crude oil producer, is shrinking and there has not been a significant oil reserve discovered in eastern China that could back up the country's oil production in the near future.

Thye say it will take three to five years before China can fully develop oil resources in the Tarim Basin in Xinjiang Uygur Autonomous Region because of poor natural conditions in that desert area and limited financing ability, even though Tarim is reported to hold the richest oil reserve in China.

Lu Renjie, director of the Shengli Petroleum Administrative Bureau, said the plan, which was studied by experts in the China National Petroleum and Natural Gas Corporation in August requires Shengli to discover at least 100 million tons of oil reserves a year during the 1991-95 period—that of the Eighth Five-Year Plan.

Shengli, which produces about 25 percent of China's crude oil—about 138 million tons last year—should pump 34 million tons of oil in 1995.

Its total oil output during the five-year period will be 168 million tons, 6.2 million tons more than the previous five-year period.

At present Shengli has 61 oil and gas fields and works on an area of 37,000 square kilometres. It produced about 33.4 million tons of crude oil last year.

The five-year plan calls for an investment of 4.6 billion yuan ($978 million) to drill 1,200 testing wells. Deputy director Liu Xingcai said explorations will be undertaken on 50 small onshore areas.

Analysts say rising oil prices on the world market after Iraq's invasion and annexation of Kuwait in August may spur the central government and Shengli to invest the money. Oil futures prices on the European market were about $30 a barrel on Thursday.

Liu said that the coastal plain surrounding the Bohai Bay, where Shengli is located, may be the area holding the richest oil reserve in coastal China. A total of 6.4 billion tons of reserve has been proven by the end of 1989.

The deputy director predicted that there may be large oil and natural gas reserves that have not been found in the areas because of the complicated geological structure underground.

And there is a vast area in Shandong that has not been tapped. The province has five sunken basins underground and a vast offshore area. Most of the present exploration and drilling is concentrated on the Jiyang Basin.

Liu said that there may be oil resources in the sea where the Yellow River empties into it.

China started to explore oil resources in North China in the mid-1950s. The Shengli Petroleum Administrative Bureau was established in 1964 on the vast alluvial soil of the Yellow River delta.

In 1986, local people built a long bank on the shallow water of the Bohai Sea and started to construct Gudong Oilfield on China's youngest land. The oilfield, located on the coast north of the Yellow River mouth, now produces 5 million tons of crude oil a year and has become one of Shengli's major oil production areas.

In another development, Shengli is ready to undertake large-scale development of offshore oil reserves in an area five to seven kilometres off Gudong called

Chengdao. About 500,000 tons of crude oil will be produced in the area during the initial development period in 1995.

A conference is scheduled for this week at which experts in the field will consider the best way of developing the Chengdao oil resources.

Director Lu Renjie estimated there are about 200 million tons of oil reserves under Chengdao, which is three to 11 metres deep.

Shengli at present has five oil platforms test drilling in the area.

He said Shengli is planning to construct a man-made island offshore to drill 50 to 60 wells. Total costs will be about 40 million yuan ($8.5 million).

It will also send out several small oil platforms. Each platform, which returns to harbour in winter, is designed to produce 300,000 tons of oil a year.

Development Strategy for Nuclear Power Explored

906B0071A Chengdu HE DONGLI GONGCHENG [NUCLEAR POWER ENGINEERING] in Chinese Apr 90 pp 49-54, 59

[Article by Ren Dexi [0117 1795 2569], Hengyang Engineering College: "An Investigation of China's Nuclear Power Development Strategy"]

[Text] Abstract. Developing nuclear power is an objective requirement of energy conversion and energy replacement and thus is a component of China's energy strategy; guiding principles regarding the scale of nuclear power development in China and its geographical disposition are worked out, and the technical strategy for the development of China's nuclear power industry is explained.

A nuclear power development strategy consists of the choices and policy decisions that are made, with reference to China's circumstances, regarding the program, guidelines and technology policy for the development of the nuclear power industry. It includes guiding principles regarding the scale of development and its geographic disposition, the selection of reactor types and fuel cycles, follow-on reactor types, and the methods and pace of implementation. The present paper is a preliminary investigation of China's nuclear power policy.

I. Developing Nuclear Power Is an Objective Requirement of Energy Conversion and Replacement

Energy development and conversion are factors with a major influence on a country's level of economic development, its energy and resource capabilities, and its scientific and technological level. In the first energy revolution, world energy development advanced from the use of wood and charcoal to fossil fuels, and it is currently in the midst of a second energy revolution in which fossil fuels themselves are being replaced, primarily by nuclear power.

The main reasons that nuclear power can replace fossil fuels are as follows: (1) resources of fossil fuels are limited; (2) nuclear power resources are abundant and have high energy density and low transport requirements; (3) nuclear power is safe, clean, reliable, and economical; (4) nuclear power technology is already mature and is advancing to even higher levels.

Thirty years of development and expansion of nuclear power demonstrate that it is rapidly replacing fossil fuels. By the end of 1988, 429 nuclear power plants had been built, with a total installed capacity of 310,812 MWe, and a further 105 plants are now under construction, with a planned installed capacity of 84,871 MWe [1]. Nuclear generating capacity in 1988 was 1794.4 TWh [terawatt-hours], representing more than 16 percent of world electrical generating capacity. Nuclear power accounted for 5.10 percent of world o73 primary energy resources in 1987 and is expected to account for 10.24 percent by the year 2000 and for 22.60 percent by 2030. Trends in world energy conversion and replacement are shown in Table 1 and Fig. 1.

It is obvious that nuclear power is in the process of replacing fossil fuels. It is predicted that after the mid-21st century, nuclear power is likely to become the chief energy source, supplanting coal in first place. If the recently reported discovery of "room-temperature nuclear fusion" is confirmed, it will rapidly be converted into productive capacities and nuclear power will quickly replace fossil fuels.

II. Actively Developing Nuclear Power Is a Component of China's Energy Strategy

China's development and expansion of nuclear power is consistent with the laws of energy conversion and replacement and is a component of China's energy development strategy.

A. Alleviating Resource Shortages by Means of Energy Policy

China's energy resources are rather abundant. For example, its coal reserves total 845.86 billion tons and are the third most abundant in the world. Its unused hydropower resources total 676 GW [gigawatts], of which 379 GW is developable [3], placing it first in the world. But China's per-capita energy supply is not large: it is only about half the world per-capita figure. China's per-capita hydropower supply is only 2700 kW, smaller than those of the US, the Soviet Union, Brazil and Canada. Per-capita coal reserves total only 700-odd tons: not only are the per-capita resources of the US, the Soviet Union and Australia several tens of times greater, but even those of Poland, the UK and Canada are much higher than China's. As a result, if we take the long view and think in strategic terms, developing nuclear power is a way of solving problem of inadequate energy.

B. Alleviate and Resolve the Problem of China's Uneven Energy Distribution

More than 60 percent of China's coal deposits are in North China, primarily in Shanxi and Nei Monggol; more than 70 percent of its hydropower resources are in the Southwest, primarily in Yunnan, Guizhou, Sichuan and Xizang. But the industrial districts are primarily in the coastal belt of North China, East China, and South China; thus developing nuclear power in these districts, which are far from the energy bases, not only will solve current energy shortage problems, but will also alleviate the problems of "hauling northern coal southwards and western coal eastwards" and "transmitting western electrical power eastwards." It can also relieve the pressure on the transport system, especially as regards coal transport, which currently is the foremost user of China's transport capacities.

C. Improve China's Energy Structure and Lessen Environmental Pollution by Fossil Fuels

China's energy structure has always been based primarily on coal. Its 1985 energy output was 855 million tons of

standard coal; of this total, coal accounted for 72.8 percent, petroleum for 20.9 percent, natural gas for 2.0 percent, and hydropower for 4.3 percent [3]. This consumption structure is not entirely rational; developing nuclear power can improve China's energy o73 structure, and it is of particularly great significance for the energy-poor regions.

Chinese coal has a sulfur content of up to 1.72 percent, and every year about 20 million tons of sulfur dioxide is discharged into the atmosphere, giving rise to serious acid rain problems in certain regions. Little of China's coal is washed, and its ash content may be as high as 23 percent. At present, China discharges about 20 million tons of flyash a year, an average of 2 tons for every square kilometer of land in the country, which is double the world average. In 1984, total world consumption of raw coal was 3.9 billion tons, and it is predicted that in the year 2020 China alone will consume 3.2 billion tons. Thus, by then, amounts of flyash and sulfur dioxide almost equivalent to the current world amounts will be concentrated in China, primarily in its economically developed regions: if we do not develop nuclear power, unthinkable pollution will result.

III. The Disposition of Nuclear Power Should Be Primarily in the Coastal Zone

Energy development has always been closely related to energy requirements. China's nine coastal provinces and municipalities are energy-poor (Table 2). According to 1985 figures, the energy consumption of these nine jurisdictions was 235.61 million tons of standard coal [3], of which 56 percent, equivalent to 186 million tons of raw coal, had to be shipped in from outside the region. The nine jurisdictions' energy output for the year was 12.03 percent of the national total, their energy consumption was 30.59 percent of the total, and their social product was 566.8 billion yuan, 34.76 of the national total. Even if these jurisdictions' energy resources were fully utilized, they would still not be sufficient for the rapid development of industry, farming, construction, transport and commerce. In addition, it is predicted that the nine jurisdictions' energy consumption in the years 2000 and 2020 will be respectively 474 million and 960 million tons of standard coal; in terms of the current energy structure (with coal accounting for 70

), this is equivalent to respectively 462 million and 960 million tons of raw coal. It is obvious that so great a demand cannot be met by the jurisdictions' own energy output. Bringing energy in from outside would require excessive transport capacity, haulage distances would be excessive, and the railroads would be hard-pressed to handle the demand. In addition, there would be serious environmental pollution, and both national economic benefits and enterprise economic benefits would be poor. Shanghai. Jiangsu, Zhejiang, Fujian, Guangdong, Guangxi and Yunnan are especially far from energy bases, and if nuclear power is not developed, meeting the energy needs for their future agricultural and industrial development will become even harder.

In dealing with the above problems, the experience of energy-poor countries or countries where the energy resources are far from industrial districts as France and the Soviet Union is worth absorbing. In the wake of the 1973 oil crisis, the French government decided that all new power plants built thereafter would be nuclear, and that no more fossil-fired plants would be built. In the Soviet Union, 80 percent of the industry and 75 percent of the population are in the European zone, while about 90 percent of fossil fuel deposits are in the Asian USSR. In the early 1960's, the European USSR was both the center of energy consumption and the base of energy production. Starting in the 1970's, the Baku oil fields and the Donbass coal fields became increasingly exhausted, and the European USSR's energy resource output fell from 75 percent of the total in 1970 to 40 percent in 1979. The center of o73 energy production shifted eastwards, so that the European USSR began to face difficulties. In 1976, the 25th CPSU party congress decided to "vigorously develop nuclear power in the European USSR." In fact, the construction of fossil-fired power plants in the European USSR has ceased, and the region's steadily growing electric power requirements are all being met by nuclear power.

China should learn from the Soviet and French experiences. In this century, based on the construction of the Qinshan and Dayawan nuclear power plants, fossil-fired power generation, hydropower and nuclear power are being developed concurrently in both North China and South China. After the year 2000, in East China and South China, and particularly in six jurisdictions, only nuclear power plants will be built, and there will be little or no construction of fossil-fired power plants. This is a necessity of national economic development and a far-sighted component of China's economic and energy strategy.

IV. The Scale of Nuclear Power in China

Based on China's energy resource distribution, fossil-fired power will play the main role in the development of electric power generation in northern China, hydropower will do the same in western China, and nuclear power will do so in eastern China. The objective of China's nuclear power program through the year 2000 is to have completed 6.50 GW of capacity and to have an additional 6.00 GW under construction. There are various views regarding the scale of nuclear power after the year 2000. Some suggest that an effort should be made to construct 30.00 GW of capacity by the year 2015. But this idea is based only on current conditions and lacks a sense of necessity and urgency regarding the development of nuclear power. The present writer believes that in developing a program for the nationwide development of nuclear power, we must proceed in terms of the following three factors.

A. Energy Requirements and Energy Resources. The need to develop nuclear power in regions that have high energy requirements, that are of critical importance for

promoting economic development, and in which conventional energy resources are unavoidably in short supply, is a foregone conclusion.

B. Transport. The regions with energy needs and with a lack of energy resources can be further subdivided, in terms of coal haulage distances by rail, into three categories:

1. Those with coal haulage distances about equal to the national average haulage distance of 500 km should not consider the development of nuclear power in the near term. For example, in Beijing and Tianjin, if nuclear power were pursued by building power plants on the coast and transmitting the electricity to the cities, the primary reason would be in order to clean up the environment. In the short term the energy requirements of these two cities can be met from pithead fossil-fired plants in the North China power grid.

2. Areas in which the coal haulage distance is about twice the national average, i.e., 1000 km, should rely primarily on fossil-fired power generation (and hydropower), with some development of nuclear power as their resources permit: examples are Liaoning, Yunnan, and Jiangxi. o73 3. Seriously coal-poor areas to which the coal haulage distance is 3 or more times the national average (1500 km or more) should focus primarily on fossil-fired power and hydropower until the year 2000 with nuclear power playing a secondary role; after the year 2000, they should in principle focus entirely on nuclear power, with little or no construction of new fossil-fired power plants.

C. Economy, Funding, and Technical Feasibility of Nuclear Power

Based on the above factors, the development of nuclear power must be given priority in Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong and Guangxi, and in particular we must not hesitate to accelerate the development of nuclear power there after the year 2000.

In 1985, the energy output of these six jurisdictions was 40.387 million tons of standard coal and their energy consumption was 129.19 million tons. The amount of energy resources shipped in was 2.2 times the amount produced: thus, their energy self-sufficiency rate is only 30 percent, and nearly 70 percent of their energy requirements must be shipped in. With the rapid economic development of these areas, the percentage of their energy requirements that is shipped in most not be increased. Using the "system investment comparison method," the coal system (including coal mines, railroads, ports, ships, coal-fired power plants and environmental management) and the nuclear power system (uranium mines, refining, conversion, processing, nuclear power plants and waste management) involve approximately the same construction investment. It is universally recognized that nuclear power is most economical in areas that are far from coal production bases. The energy consumption of these six jurisdictions in 1985 was 16.75 percent of the national energy consumption of 770 million tons, and their electric power consumption was 23.5 percent of the national total of 411.76 TW; it is predicted that in the year 2000, their energy consumption will be 260 million tons and their electric power consumption 283.0 TWh. Their installed nuclear capacity is about 5 GWe, generating 30.0 TWh of energy [annually]. After the year 2000, the energy output of the 6 jurisdictions will increase by 5 percent each year, so that by 2015 their electrical energy output will be 557.0 TWh, of which fossil-fired power plants will contribute 210.0 TWh, hydropower and tidal power stations 88.0 TWh, and nuclear power 259.0 TWh. This prediction assumes the construction of fewer fossil-fired power plants and a focus on nuclear power plants. Nationally, including such provinces and cities that hope to build nuclear power plants as Liaoning, Hunan and Jiangxi, national nuclear power generating capacity in the year 2015 is likely to reach 300.0 TWh, with a total installed capacity of 50.0 GW. In other words, after the year 2000, three nuclear plants of the 1000-mW class will come on stream every year. At this rate, in the year 2015 nuclear power generation will account for about 10 percent of total national electric power generation.

V. Nuclear Power Technology Policy

Nuclear technology policy is critical to success or failure in the development of nuclear power. The selection of a reactor type is an area where there are both successful foreign experience and lessons of failure). The US tried out more than 20 reactor types, ultimately selecting light water reactors; France, West Germany imported and learned from US reactor technology and successfully developed pressurized water reactors [PWR's]; Canada conducted o73 independent research and developed a heavy water reactor; England initially developed the gas-cooled reactor and subsequently went through continuing disputes regarding the choice of reactor type, with a great deal of vacillation, with the result that its nuclear power industry stagnated for more than a decade. China should learn from all of these cases.

A. Use Pressurized Water Reactors As the Basic Type and Accelerate Chinese Production, Standardization and Series Design

After China spent the 1970's disputing over the choice between heavy water reactors and light water reactors, it is now building only nuclear power plants with pressurized water reactors. We should continue to develop this mature reactor type, accelerate its domestic production, standardization and series design. In accordance with the guideline of "combining Chinese and foreign, with a primary focus on China," we should further master nuclear power design, construction and management technology. Given China's current technological and equipment level and power grid circumstances, we need to build a group of 600-MW stations. During the Eighth 5-Year Plan, we should gradually implement the

domestic production of large-scale nuclear power stations. In the next century, we must focus on building large power plants: nuclear power plants with large unit capacity will have markedly better economic performance.

B. Accord Due Importance to Second-Generation and Follow-On Reactor Research

While building nuclear power plants with pressurized water reactors, we should accord due importance to second-generation and follow-on reactor research, with planned, deliberate, well organized development and technological tracking of thermal-neutron reactors, fast-neutron reactors, and fusion reactors.

Fast-neutron reactors have already been shown to be the only currently mature reactor type that can be used in second-generation nuclear power plants. Thermal-neutron reactor power plants consume nuclear fuel and generate nuclear power, while fast-neutron reactor power plants can generate both nuclear fuel and electric power. The fuel utilization rate of fast-neutron reactors is 70 times that of thermal-neutron reactors, which would make it possible to use China's low-assay uranium ore and the lean uranium from its isotope separation plants, thus creating extremely favorable conditions for the large-scale development of nuclear power plants after the year 2000.

In order to link China's development of fast-neutron reactors at the beginning of the next century with pressurized water reactors, we must step up research on fast-neutron reactors and strive to build commercial fast-neutron reactors early in the century (2005-2010). To realize this objective, during the rest of the present century we must make a vigorous effort in the investigation and development of experimental and demonstration fast-neutron reactors.

High-temperature gas cooled reactors (HTGR) have a high outlet temperature suitable for coal gasification, steelmaking, and thermal extraction of oil fields, thus making them a good candidate for development. While accelerating research on fast-neutron reactors, we should engage in basic research on HTGR's. When the technology is mature and it is economically feasible to do so, we should construct experimental HTGR reactors in timely fashion. o73 Fusion reactors will become commercial later than fast-neutron reactors, and they thus represent the third generation. If "room-temperature fusion" is successful in the near term, fusion reactors will move far into the lead. The fuels in fusion reactors extremely abundant, and these reactors can rapidly propagate nuclear fuel, so that involving ourselves in fusion early will promote the large-scale utilization of nuclear power. China's capabilities do not permit extensive exploration of fusion installations, and we should therefore focus on Tokamak fusion and particularly on scientific and technological tracking of fusion.

To satisfy the needs of China's large-scale development of nuclear power in the 21st century, we must focus on in-country development and concentrate on on-site work and research, but we must also import technology, including fast-neutron reactors and HTGR's.

C. In Nuclear Fuel, Focus on Domestic Sources and Establish an Economical, Advanced Nuclear Fuel Cycle System

Focusing on a domestic nuclear fuel supply laid the foundation for the development of the nuclear power industry. Establishing an economical, advanced nuclear fuel cycle system is the key to assuring the sustained, stable, rapid development of China's nuclear power industry.

The first step is effective work in uranium geology and development of uranium resources. As a rule, 15 years is required from the discovery of a uranium deposit to the establishment of a base, certification of reserves, and the construction of a medium-scale uranium mine, and as a result, the geological work for uranium mines must be done far in advance. For example, achieving an installed nuclear power plant capacity of 30.0 GW in the year 2015 will require a supply of 1500 to 1700 tons of natural uranium in the year 2001 and of 5500 tons in 2015. As a result, we must continuously develop uranium resources and effectively prepare and develop recoverable uranium. In addition, we must accelerate research and production activities in the fields of uranium concentration and fuel elements.

The second step is research on the reprocessing of power reactor fuel elements and the establishment of a robust nuclear fuel cycle system. The reprocessing of spent fuel and the re-use of uranium and plutonium can greatly decrease the need for natural uranium and for capacities for the concentration of U-235. The uranium fuel reprocessing cycle for LWR's [light water reactors] can decrease natural uranium requirements by 15-20 percent, and if the plutonium that is produced is all recycled, the amount of natural uranium used will be decreased by 30 percent. By the middle or late 1990's we must establish intermediate experimental post-processing plants, and at the beginning of the next century we must build industrial-scale plants with a processing capacity of several hundred tons per year. In addition, technology-policy decisions regarding spent fuel element storage and transport, waste management, and the ultimate disposal or recycling of uranium and plutonium fuels must be made.

VI. Establish an Unswerving Policy of Nuclear Power Development

China already has a 25-year history as a nuclear country. But developing nuclear power is an arduous undertaking. Although an excellent beginning was made with the construction of the Qinshan nuclear power plant, we must develop rapidly in the future, develop a common awareness, maintain an unwavering o73 trust in the strategy of nuclear power and a resolution to carry it out,

take strategic measures, carry out the program effectively, arrange for the necessary investments, pursue preferential policies, and vigorously develop nuclear power.

First, we must make the development of nuclear power a basic national policy and conscientiously and effectively carry out the long-term program. Our strategic conception must be embodied in a program that specifies the scale of development, its pace and disposition, our technology policy, and general and particular principles. We must submit questions of nuclear power strategy to the National People's Congress and party congresses for discussion, draft laws, regulations and resolutions, and persist in our intent. At its 24th, 25th and 26th party congresses the Soviet Union approved a nuclear plant program and resolved to vigorously develop the manufacture of nuclear power machinery and to accord priority to the construction of nuclear plants in the European USSR, with the result that the Soviet nuclear power industry advanced vigorously. Even after the accident at Chernobyl the Soviets did not waver. This lesson is well worth pondering.

Second, we must implement the guideline of "bringing together investment capital from many quarters, concentrated construction, and unified management." It is estimated that completing the construction of 6.50 GW of installed reactor capacity in this century will require an investment of 25 billion yuan. This huge sum must be obtained from a variety of channels, including the central government, the localities, and the nuclear industry's own savings. In the initial stage of nuclear power, we first must rely on state investment or financial aid: this has been the case in all countries. In this country, Liaoning, Guangdong, Shanghai, Jiangsu, Zhejiang, Fujian, Hainan, Hunan, Jiangxi and Sichuan are eager to develop nuclear power, and some of these jurisdictions have already done large-scale preliminary work. We must organize and guide them, motivating both the central authorities and the localities, so that everyone cooperates in promoting nuclear power. The nuclear power industry itself can also make use of such methods as export credits and compensatory trade to arrange for some of the funds.

Finally, we must adopt an industry slant toward nuclear power and institute preferential policies. Low-interest loans and nuclear power tax exemptions should be instituted for nuclear power construction; policies supporting the domestic production of nuclear power equipment should be adopted; a policy of limiting the scale of development of coal-fired power plants in the energy-poor, transport-strapped, severely polluted coastal regions and in eastern and southern China and of focusing on nuclear power plant construction after the year 2000 should be adopted.

China's nuclear power strategy is the core strategy for the development of its nuclear industry and a guideline for China's future development of nuclear power. We most proceed in terms of China's real circumstances, learn from foreign experience, investigate conscientiously, and draft a correct strategy in order to guide China's nuclear power industry into a correct development orientation.

Table 1. World Energy Conversion Predictions

Year	Coal, percent	Petroleum, percent	Natural gas, percent	Nuclear power, percent	Hydropower, percent	Solar power, percent	Other energy resources (wood and the like)
1975	27.60	44.00	18.40	1.50	6.50	—	2.00
2000	29.40	35.00	18.60	10.24	5.00	0.06	1.70
2030	33.50	19.10	17.00	22.60	4.00	1.30	2.50

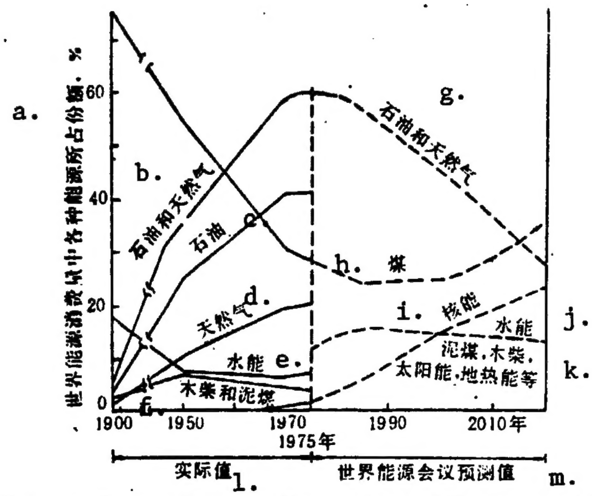

Figure 1. World Primary Energy Resource Conversion and Replacement Trends 1900-2020[2]

Key: a. Percentage of total world energy consumption b. Petroleum and natural gas c. Petroleum d. Natural gas e. Hydropower f. Wood, coal slurry g. Petroleum and natural gas h. Coal i. Nuclear power j. Hydropower k. Coal slurry, wood, solar power, geothermal power, etc. l. Actual values m. World Energy Conference predictions

Table 2. 1985 Energy Resource Output and Consumption and Income Energy Shipments (x 10^4 tons of standard coal) of Nine Coastal Jurisdictions

Jurisdiction	Total	Raw coal	Crude oil	Natural gas	Hydroelectric power	Energy resource consumption	Incoming shipments of energy resources	Incoming shipments of energy resources as percentage of energy consumption	Estimated haulage distance of incoming energy resources
Beijing	704.9	698.1			6.8	2291	1586.1	69	Average or below-average rail haulage distance* 1000km
Tianjin	611		535.2	75.8		1680	1069	64	
Liaoning	4936.8	3279.6	1317.5	199.1	140.6	6670	1733.2	23	
Shanghai						2553	2553	100	
Jiangsu	1648.7	1567	79.7		2.0	4056	2407.3	59	Average rail haulage distance calculated from figure of 1500 km
Zhejiang	265.2	107.6			157.6	1765	1499.8	85	
Fujian	619.7	433.2			186.5	1043	423.3	41	
Guangdong	864.1	580.2	14.5		269.4	2495	1630.9	65	
Guangxi	641	427.8	5.1		208.1	1008	367.0	36	
Total	10291.4	7093.5	1952	274.9	971	23561	13269.6	56	

* 1985 national average railroad freight haulage distance 636 km, average coal haulage distance 501 km[3]

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